Vegetation Production Estimates for the Rocky Mountain Research Station Restoration Plots:

Glenn, Roos and George Wright

Years 2002, 2001, and 2000

RMRS - 98180 - RJVA

Submitted by
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Thesis/
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Rocky Mountain Research Station
Glenn Ranch Treatment Plots
Synopsis of Biomass Measurements
May 7th, 2003

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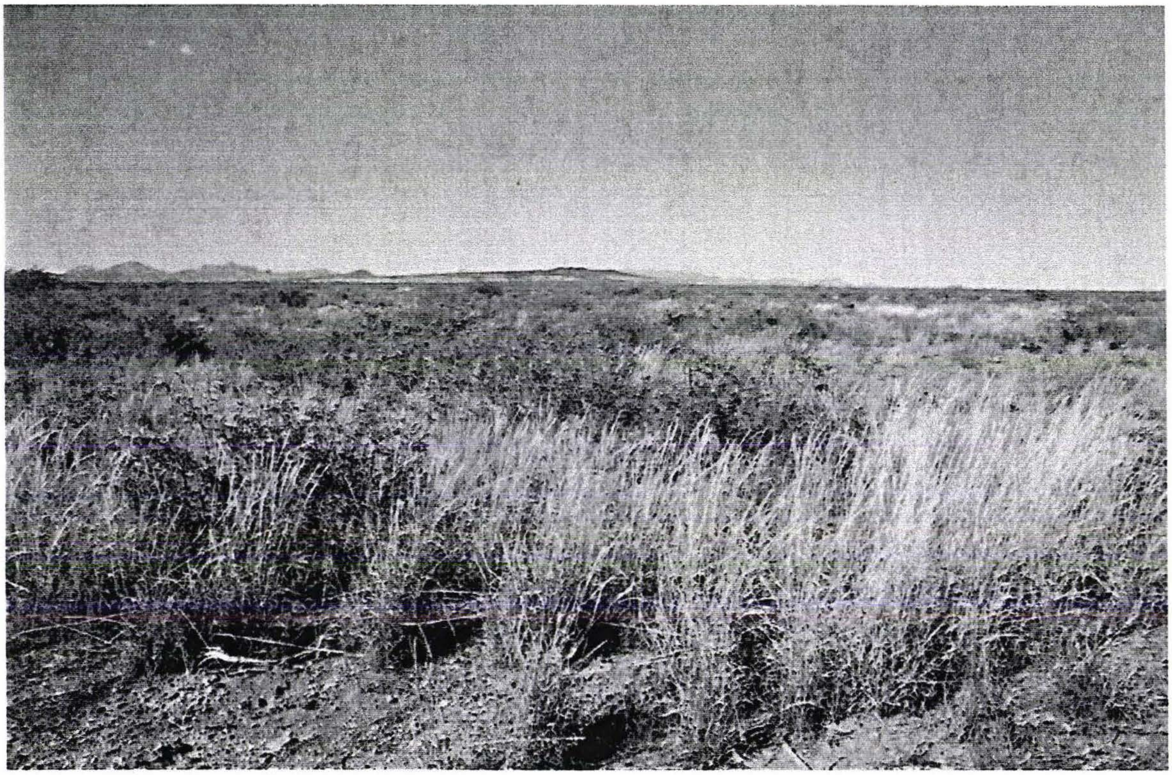

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Synopsis of biomass measurements at the Glenn Ranch

There has been an overall increase in Total Annual Production (TAP) and Perennial Grass Production (PGP) at the Glenn plots since the treatments in 1999. Chart 1 shows the increase that occurred in Total Annual Production. The chart lumps all 12 plots at the Glenn site according to their treatment type. For example, all 4 control plots are summed for their aggregate total to represent the overall increase that occurred in the control plots. The four control plots saw a 183% increase in TAP, starting at 804 lbs/acre in 2000 and increasing to 2277 lbs/acre in 2002. The crush treatment plots saw a more modest, but respectable, increase of 56% from 1381 lbs/acre in 2000 to 2166 lbs/acre in 2002. The crush and seed treatments saw the largest increase in biomass overall going from 2238 lbs/acre in 2000 to 5076 lbs/acre in the year 2002, an increase of 126% in two years time.

Chart 2 chronicles Perennial Grass Production (PGP) for the research site. The control plots saw a dramatic 192% increase from 582 lbs/acre in 2000 to 1701 lbs/acre in 2002. Again, the crush treatment plots, going from 789 lbs/acre in 2000 to 1201 lbs/acre in 2002, represented a more modest 52% increase as compared to the more dramatic 107% increase of the crush and seed treatments which yielded 4197 lbs/acre in 2002 compared to 2028 lbs/acre in the year 2000.

Charts 3, 4, and 5 provide a more detailed look at the individual plot performance for TAP. Charts 6, 7, and 8 provide performance figures for PGP on an individual plot basis.

Methods

Biomass estimates were taken during the Fall of 2002 between the dates of 1119/02 to 12/9/02 using SCS protocol (Form SCS-417) for determining production and composition. This double sampling method is described in detail in the National Handbook for Native Grazing Lands. Each treatment site contains twelve plots that measure 500 by 500 feet. One transect, consisting of ten 9.84 sq. ft. quadrats was placed in the center of each plot. Ten quadrats were sampled for herbaceous and non-woody shrub cover. Woody shrubs, such as creosote, mesquite and tarbush were not measured. Sub-shrubs, such as snakeweed and burrobrush were measured. A minimum of 2 out of the ten quadrats were clipped and weighed. Plant material averaged about 90% dry weight.

Production calculations were made using an Excel 2001 spreadsheet program. The raw data sheets, in addition to a computer disc, have been sent to Gerry Gottfried of the US Forest Service, Ron Bemis of the NRCS Douglas Field Office, and the Malpai Borderlands Group. Photo points were taken at each plot. The prints are located at the Malpai Group office and at the Forest Service office in Phoenix.

Total Annual Production (TAP) is the measurement used to describe biomass in the SCS protocol (Form SCS-417) for determining production and species composition. It is important to emphasize that TAP does not differentiate between plant groups such as annual grasses, forbs, perennial grasses and sub-shrubs. TAP also does not discriminate between desirable plants, such as plains bristlegrass (*Setaria machrostachya)*, and undesirable plants like snakeweed (*Guiterizzia sarothrae*). But for observing the dynamics of ecological succession, and the effects of precipitation (or lack thereof), TAP is an important measurement. This report also focuses on perennial grass production (PGP) as a parameter for reporting on the successes of this project. Furthermore, the grass species seeded during the treatment also receive special attention, for it is the fortitude of these particular plants and their associated treatments that are the source of our concern. Details of individual species performance can be found in the full report on file at the above named locations.

Photographic Points

Photographs were taken of each plot using a Canon Elan IIe 35mm camera. The lens used was a Tamron 28-200mm zoom lens at the 28mm setting in order to obtain the maximum field of view. Kodak Royal Gold 100 ISO print film was used, and the film was developed at Ferrari Color in Sacramento, California. A binder containing 36, 4x6 inch prints is at the Malpai Borderlands Group office and at the USFS office in Phoenix.

One photograph was taken of each plot, for a total of twelve photos at each research site. Each photo was taken at the T-post marking each corner of the plot.

Precipitation Table

Season	Glenn 2000	Glenn 2001	Glenn 2002
January to January rainfall total.	15.18	10.92	10.42
Date production measurements completed.	11/25/00	10/23/01	12/7/02
Additional rain after data was collected.	0.03	0.92	0
*Rainfall that occurred since last period of biomass measurements.	**15.15**	**10.03**	**11.34**

* This rainfall is the amount that contributed to production for the year measured.

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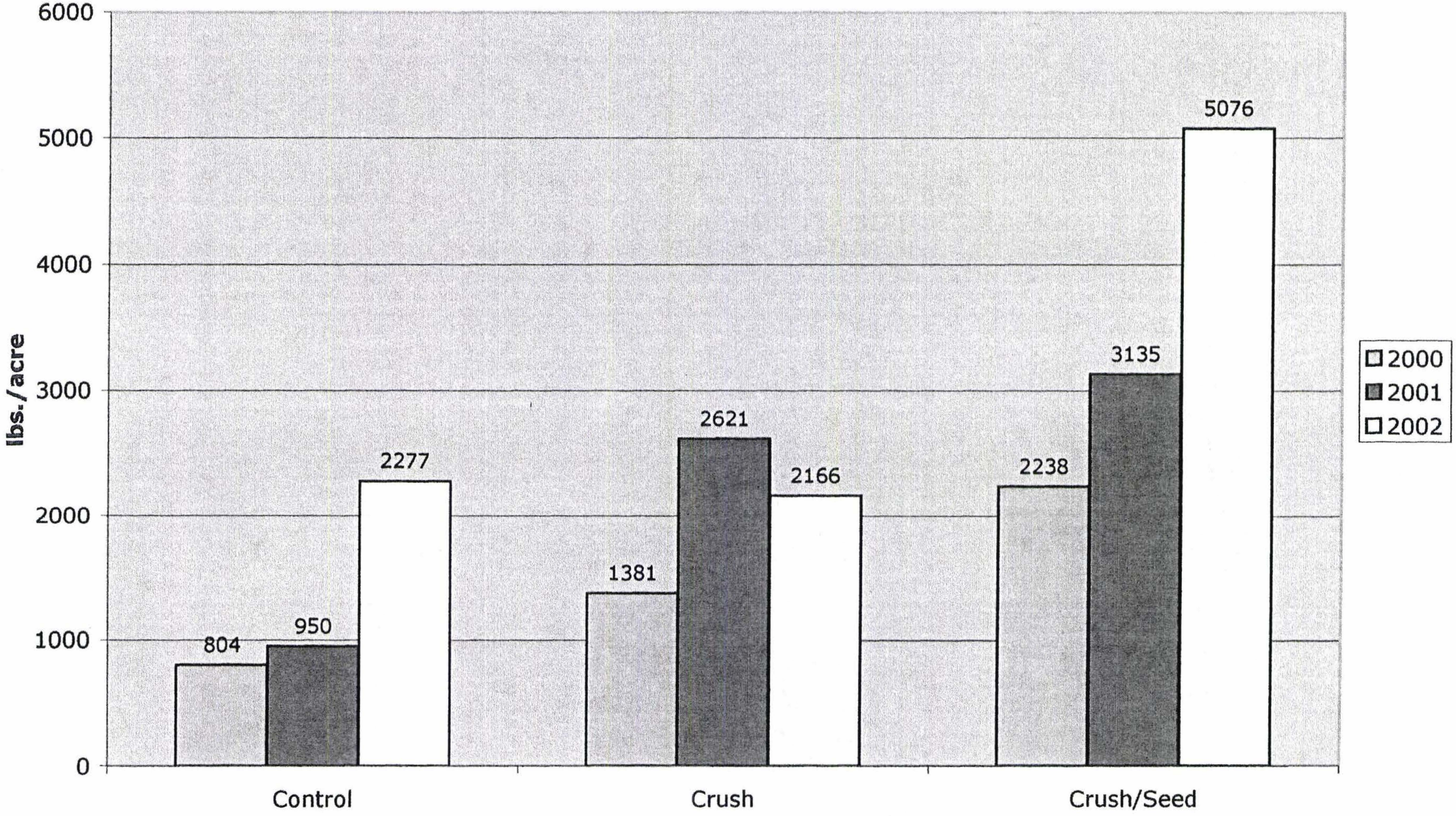


Glenn Total Annual Production
2000 to 2002
(sum of all 12 plots)

Chart 1

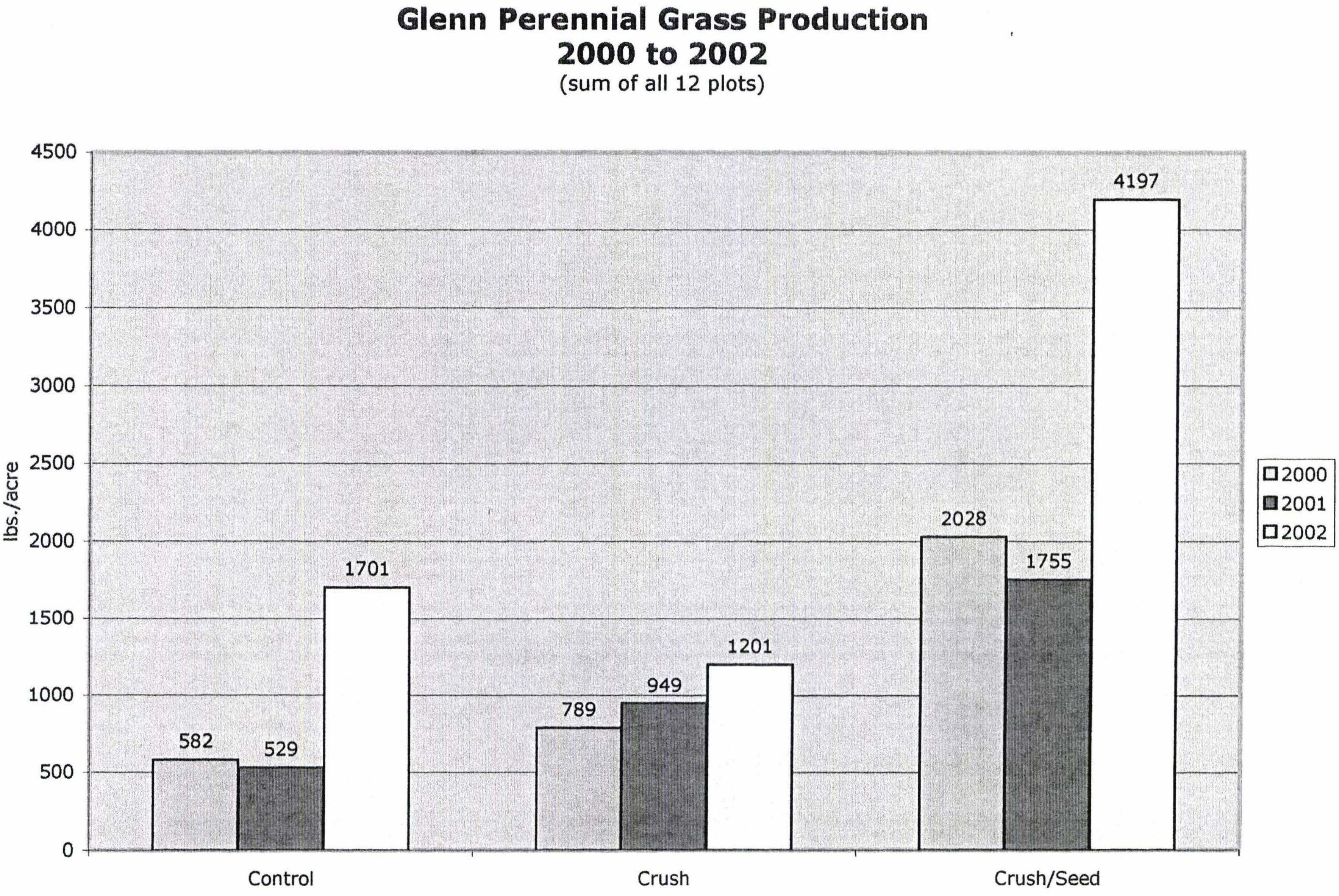

Glenn Perennial Grass Production
2000 to 2002
(sum of all 12 plots)
lbs./acre
4500
4000
3500
3000
2500
2000
1500
1000
500
0
582
529
1701
789
949
1201
2028
1755
4197
Control
Crush
Crush/Seed
2000
2001
2002

Chart 2

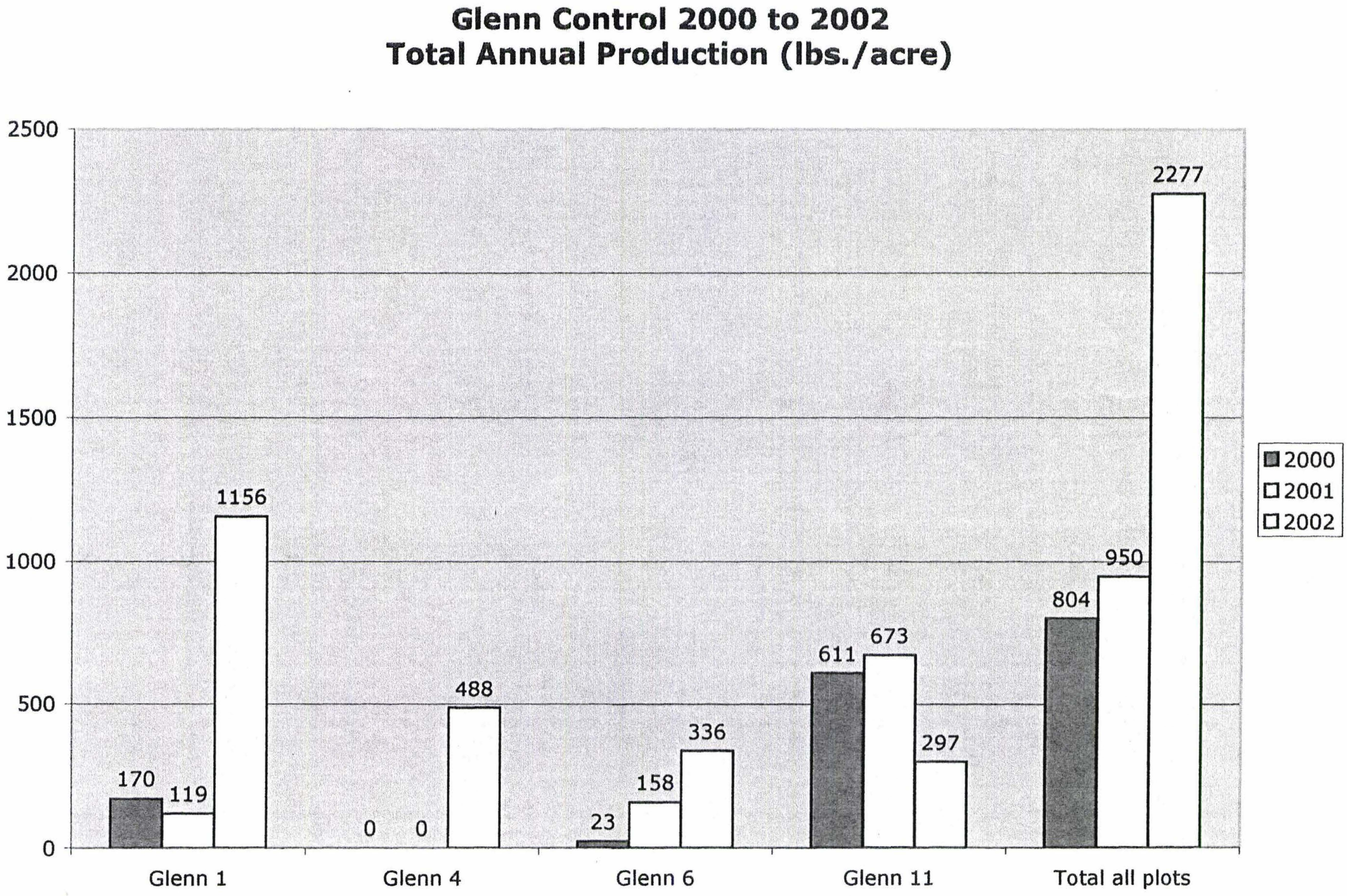

Glenn Control 2000 to 2002
Total Annual Production (lbs./acre)
2500
2000
1500
1000
500
0
170
119
1156
0
0
488
23
158
336
611
673
297
804
950
2277
Glenn 1
Glenn 4
Glenn 6
Glenn 11
Total all plots
▨ 2000
☐ 2001
☐ 2002

Chart 3

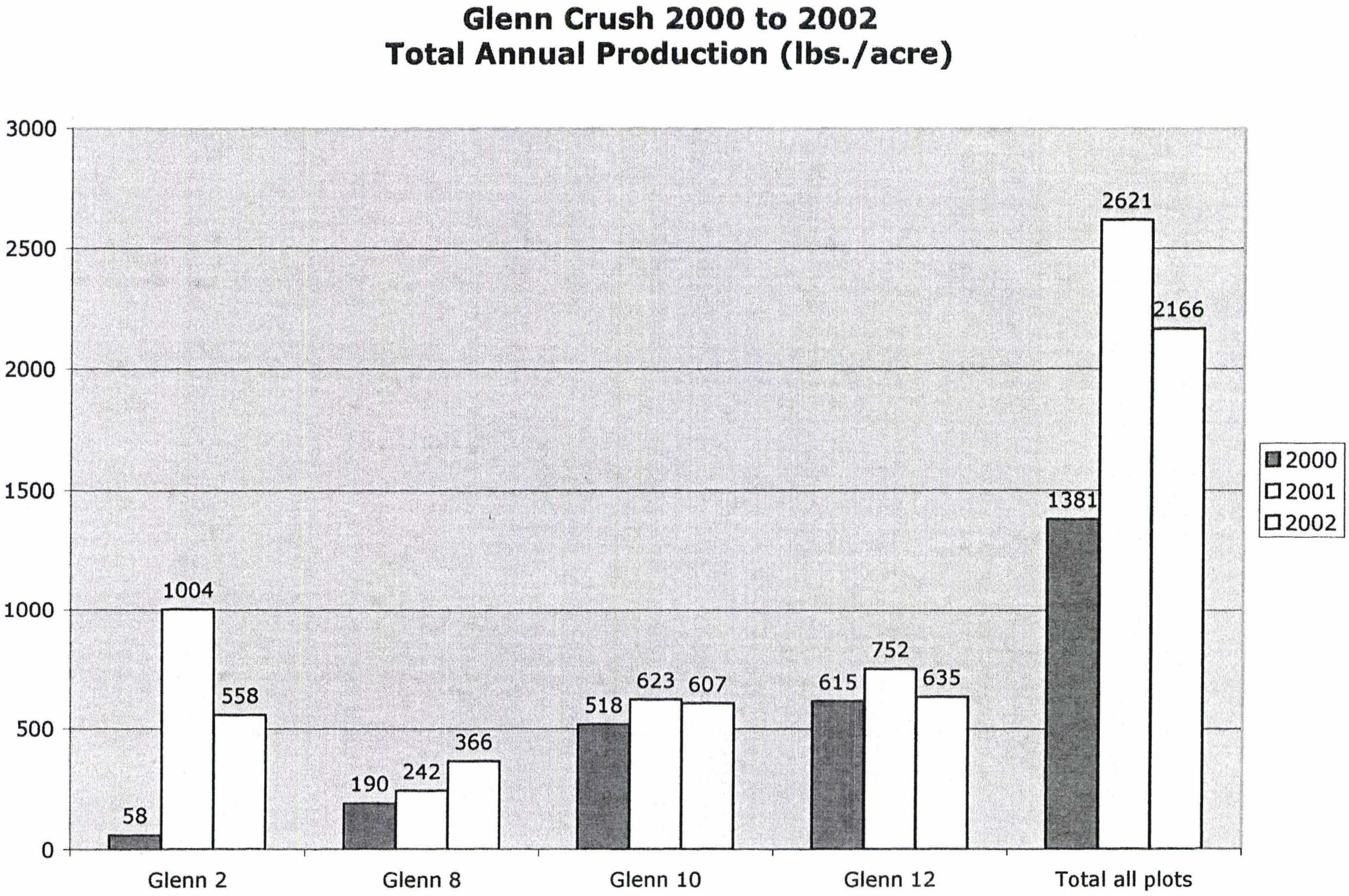
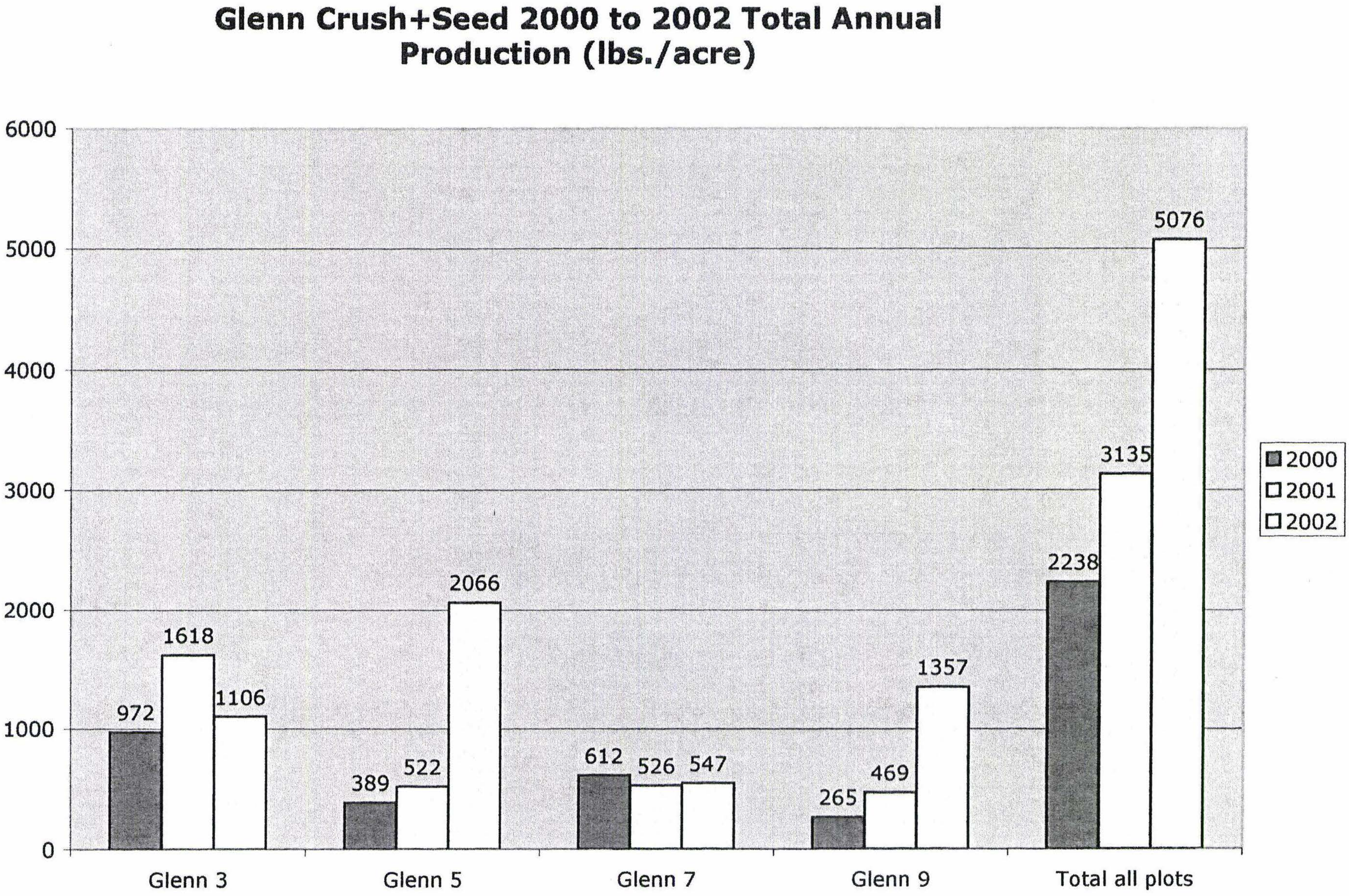

Glenn Crush 2000 to 2002
Total Annual Production (lbs./acre)
3000
2500
2000
1500
1000
500
0
Glenn 2
Glenn 8
Glenn 10
Glenn 12
Total all plots
58
1004
558
190
242
366
518
623
607
615
752
635
1381
2621
2166
2000
2001
2002

Chart 4



Glenn Crush+Seed 2000 to 2002 Total Annual Production (lbs./acre)

Chart 5

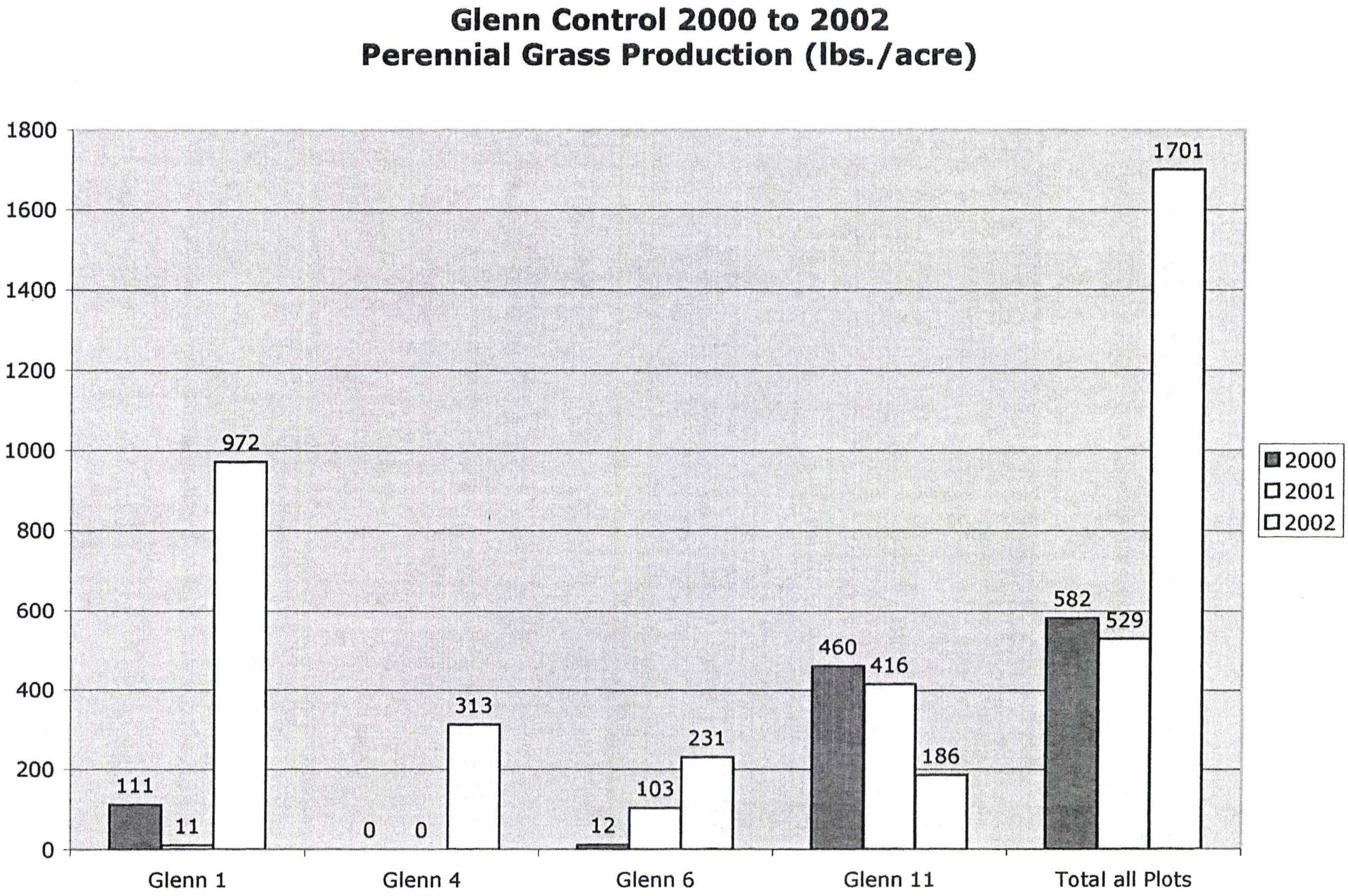

Glenn Control 2000 to 2002
Perennial Grass Production (lbs./acre)
1800
1600
1400
1200
1000
800
600
400
200
0
111
11
972
0
0
313
12
103
231
460
416
186
582
529
1701
Glenn 1
Glenn 4
Glenn 6
Glenn 11
Total all Plots
▨ 2000
☐ 2001
☐ 2002

Chart 6

Glenn Crush 2000 to 2002
Perennial Grass Production (lbs./acre)

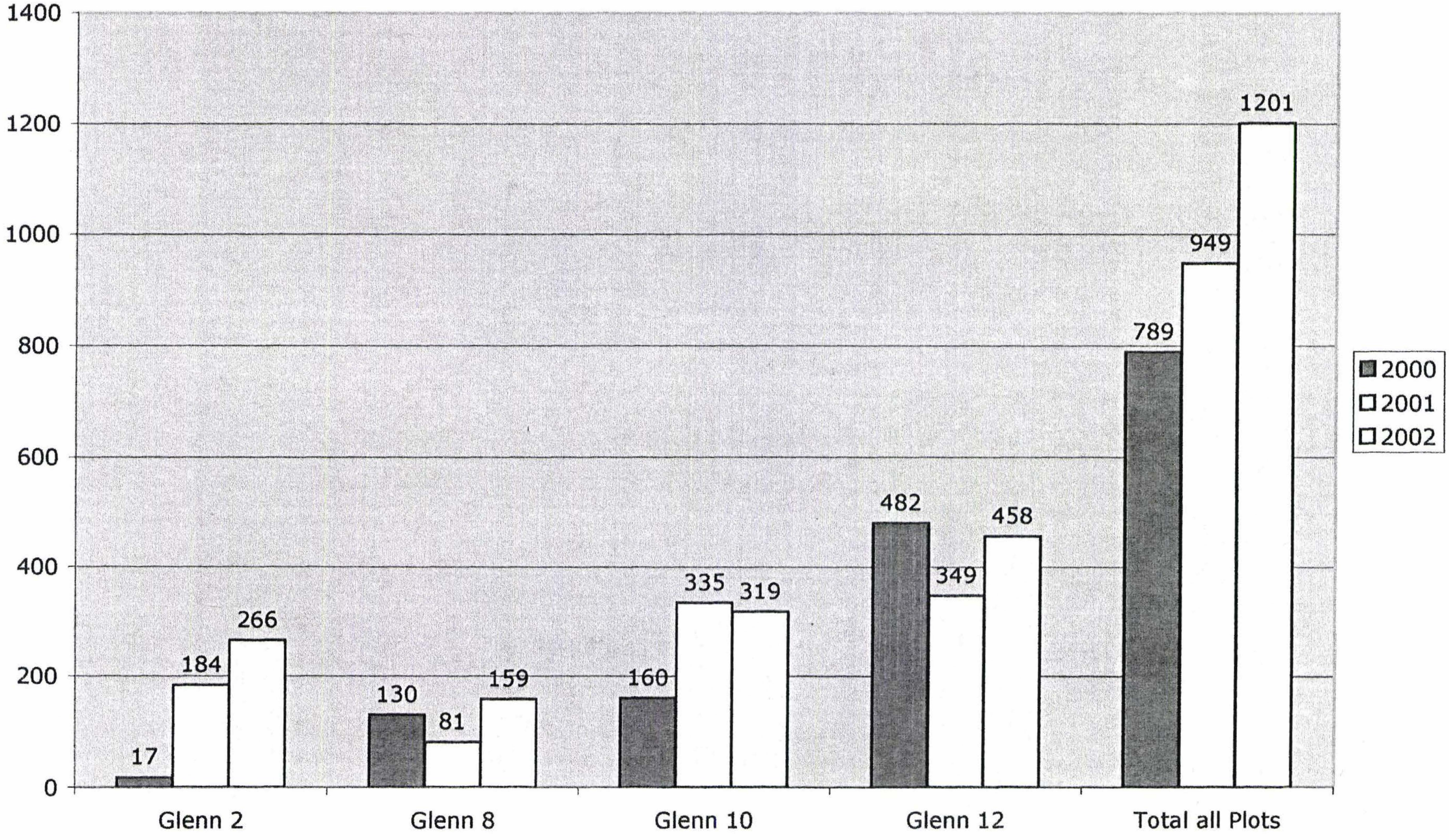


Chart 7

Glenn Crush/Seed 2000 to 2002
Perennial Grass Production (lbs./acre)

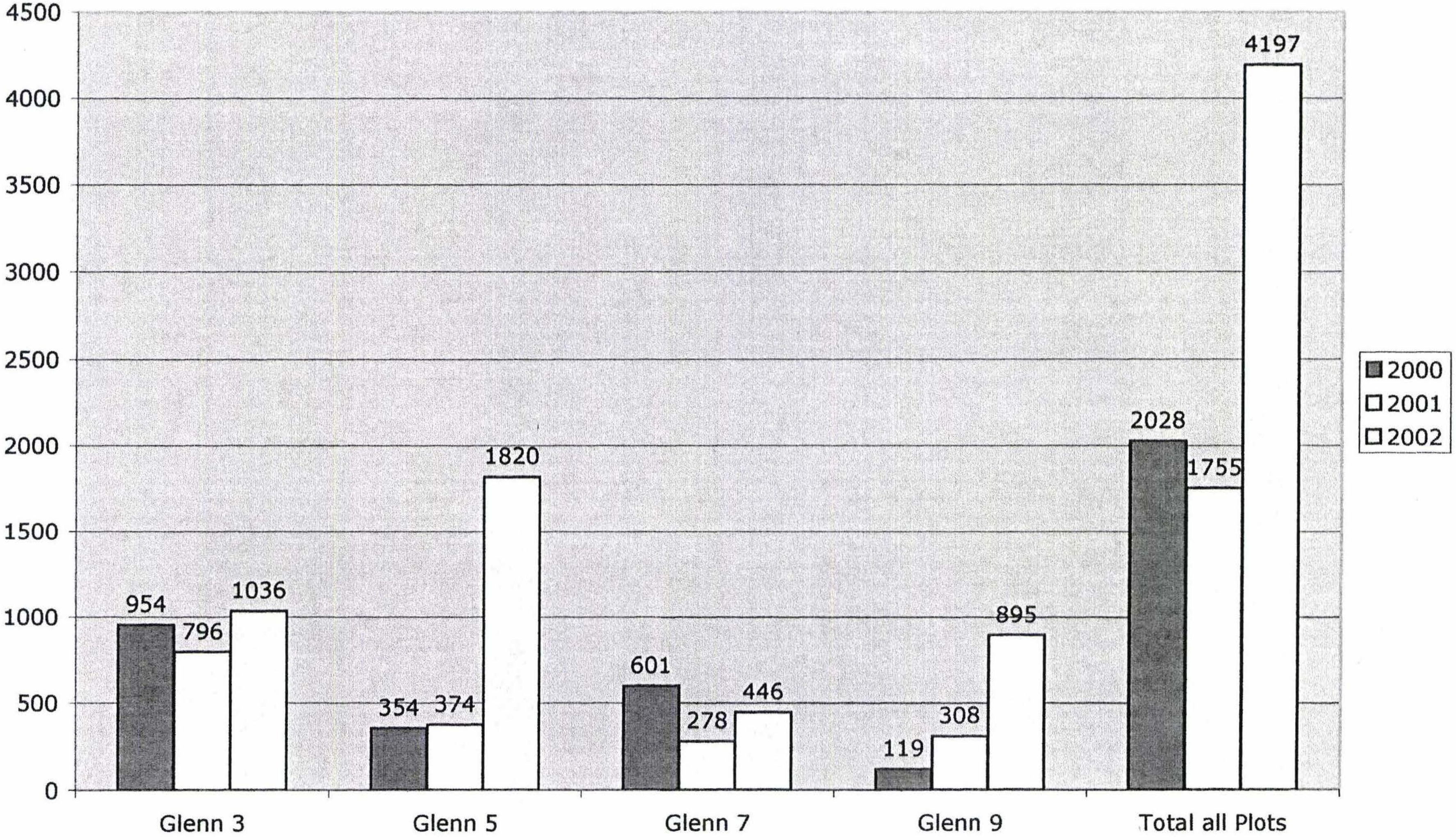
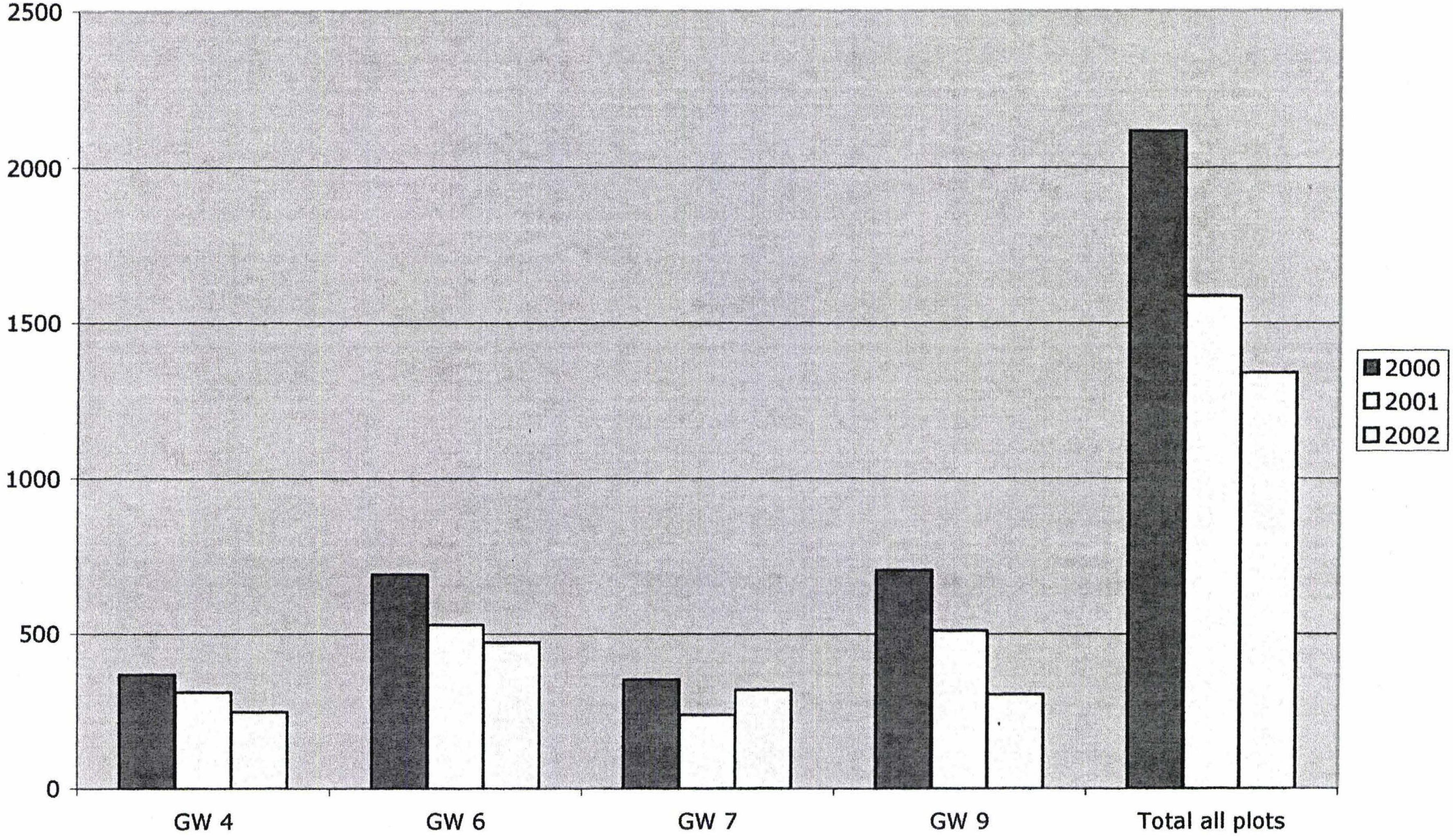
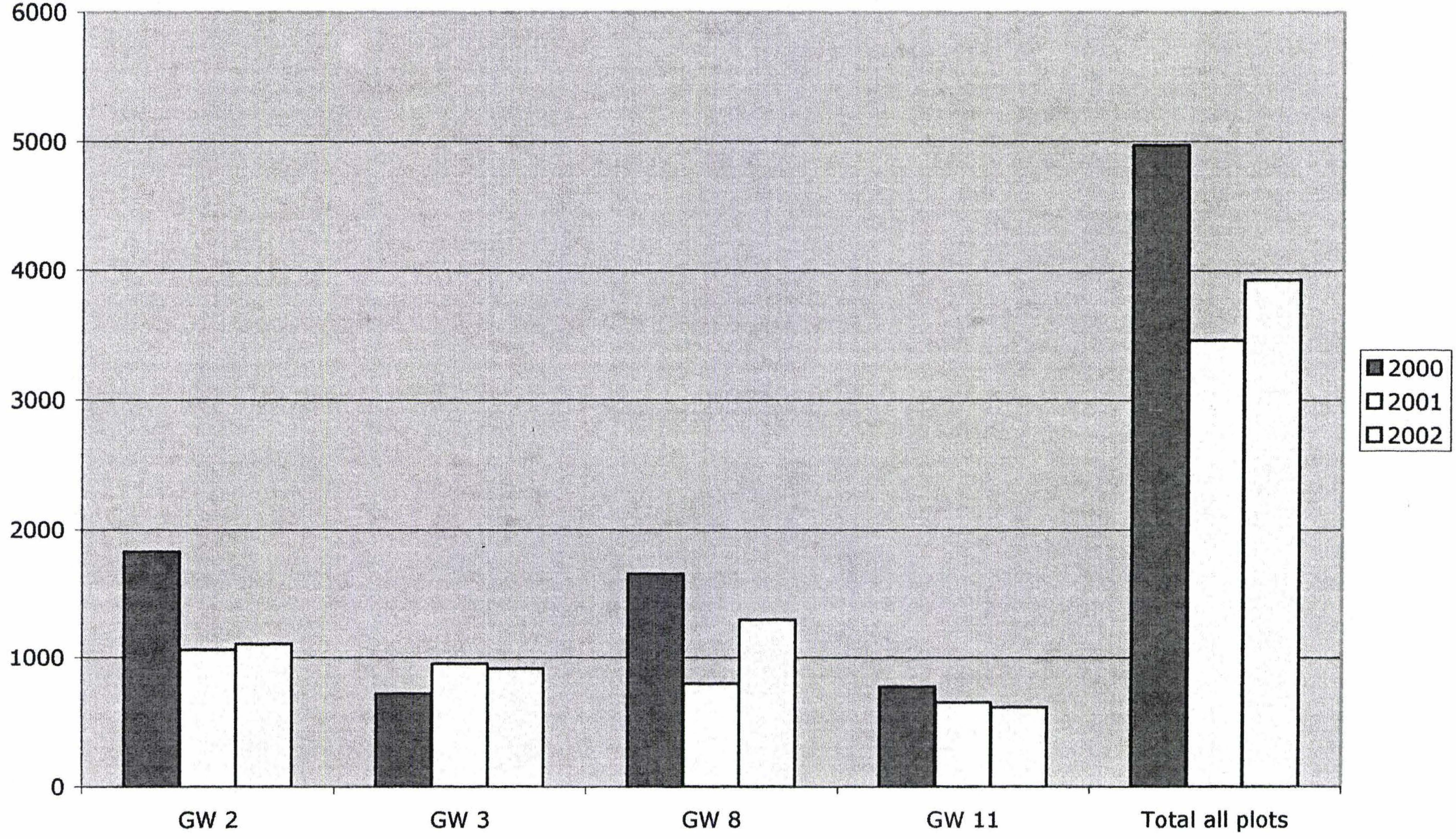


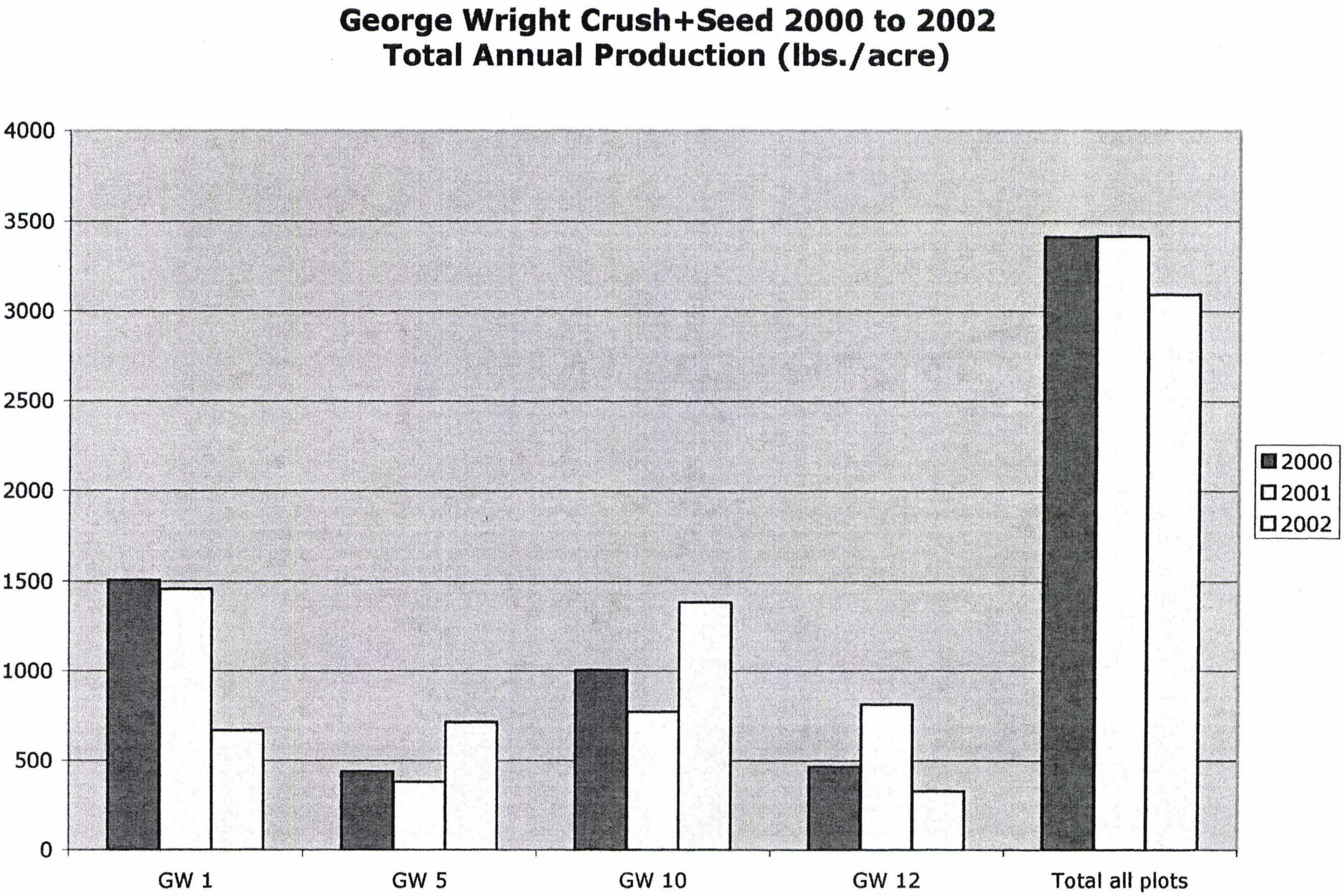
Chart 8

George Wright Control 2000 to 2002
Total Annual Production (lbs./acre)

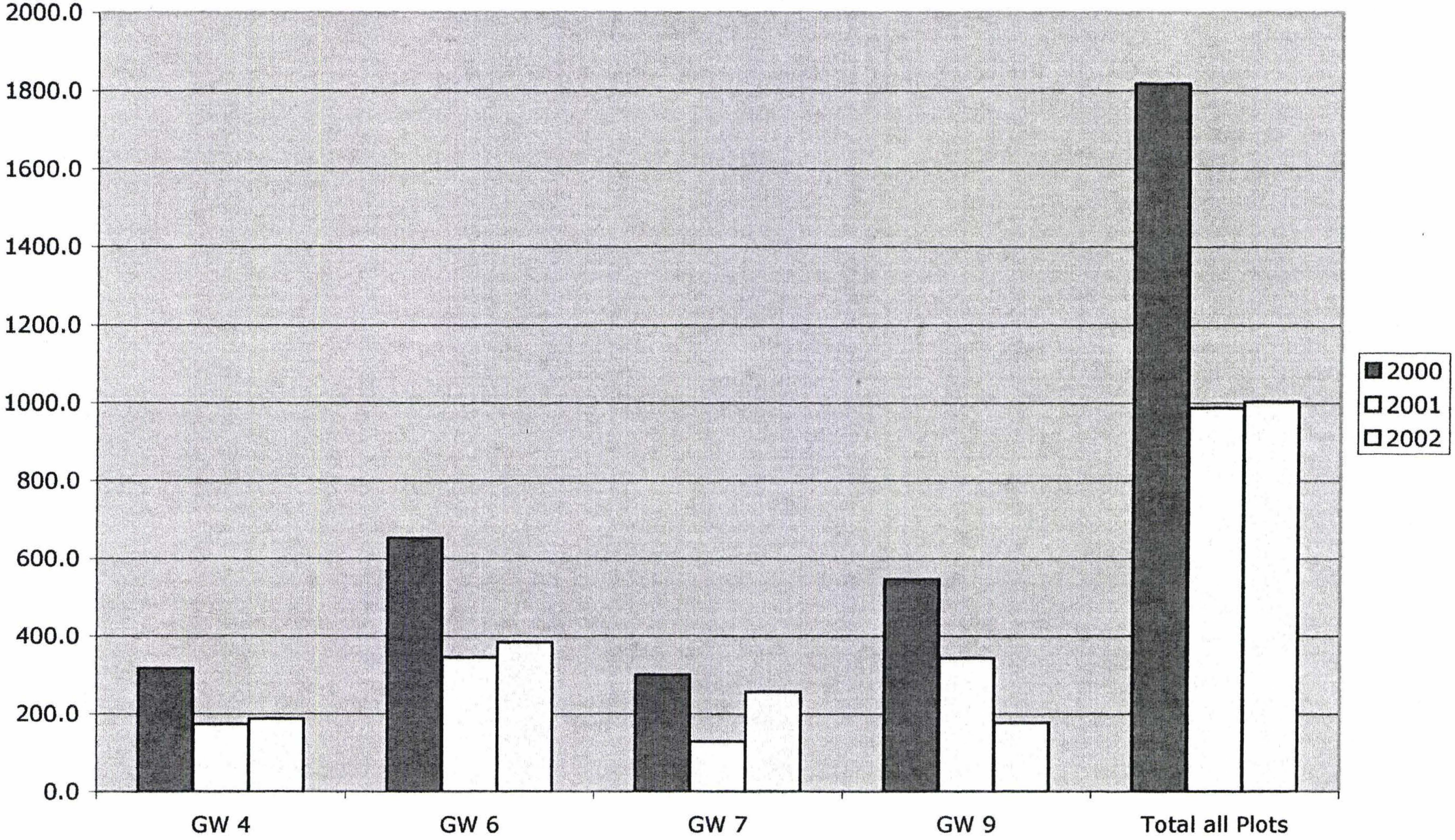


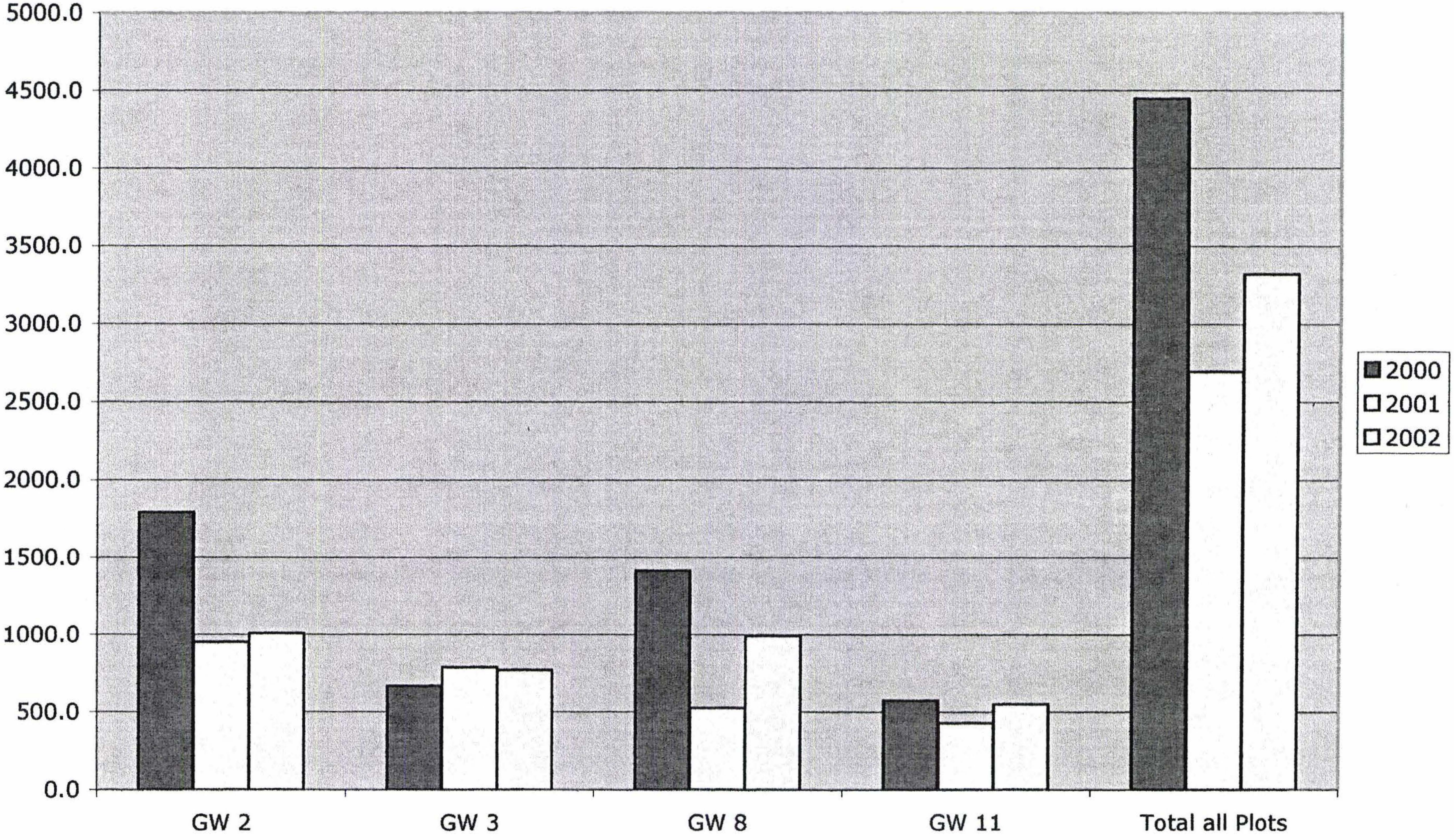
George Wright Crush 2000 to 2002
Total Annual Production (lbs./acre)




George Wright Crush+Seed 2000 to 2002
Total Annual Production (lbs./acre)
4000
3500
3000
2500
2000
1500
1000
500
0
GW 1
GW 5
GW 10
GW 12
Total all plots
2000
2001
2002

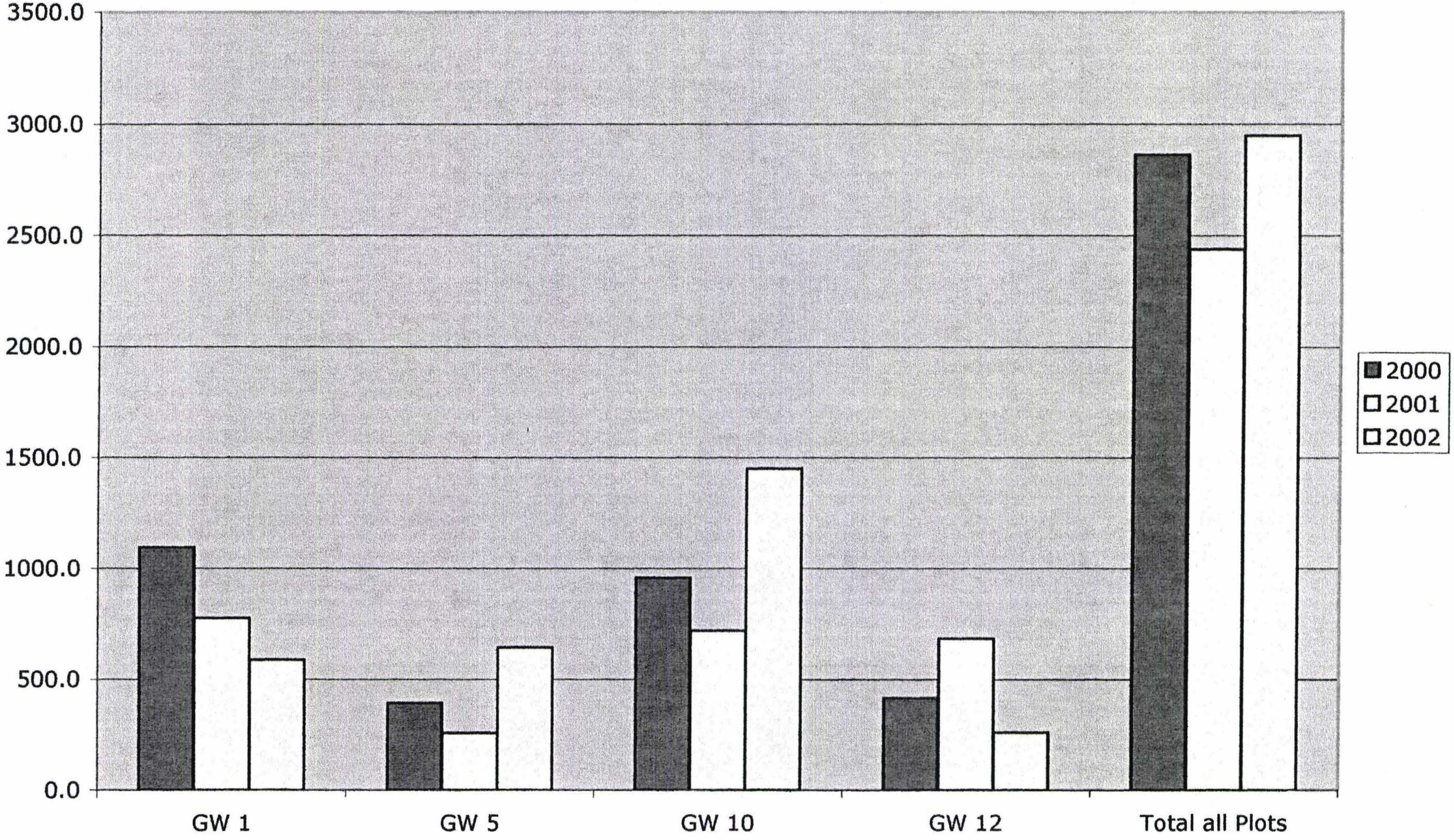
George Wright Control 2000 to 2002
Perennial Grass Production (lbs./acre)



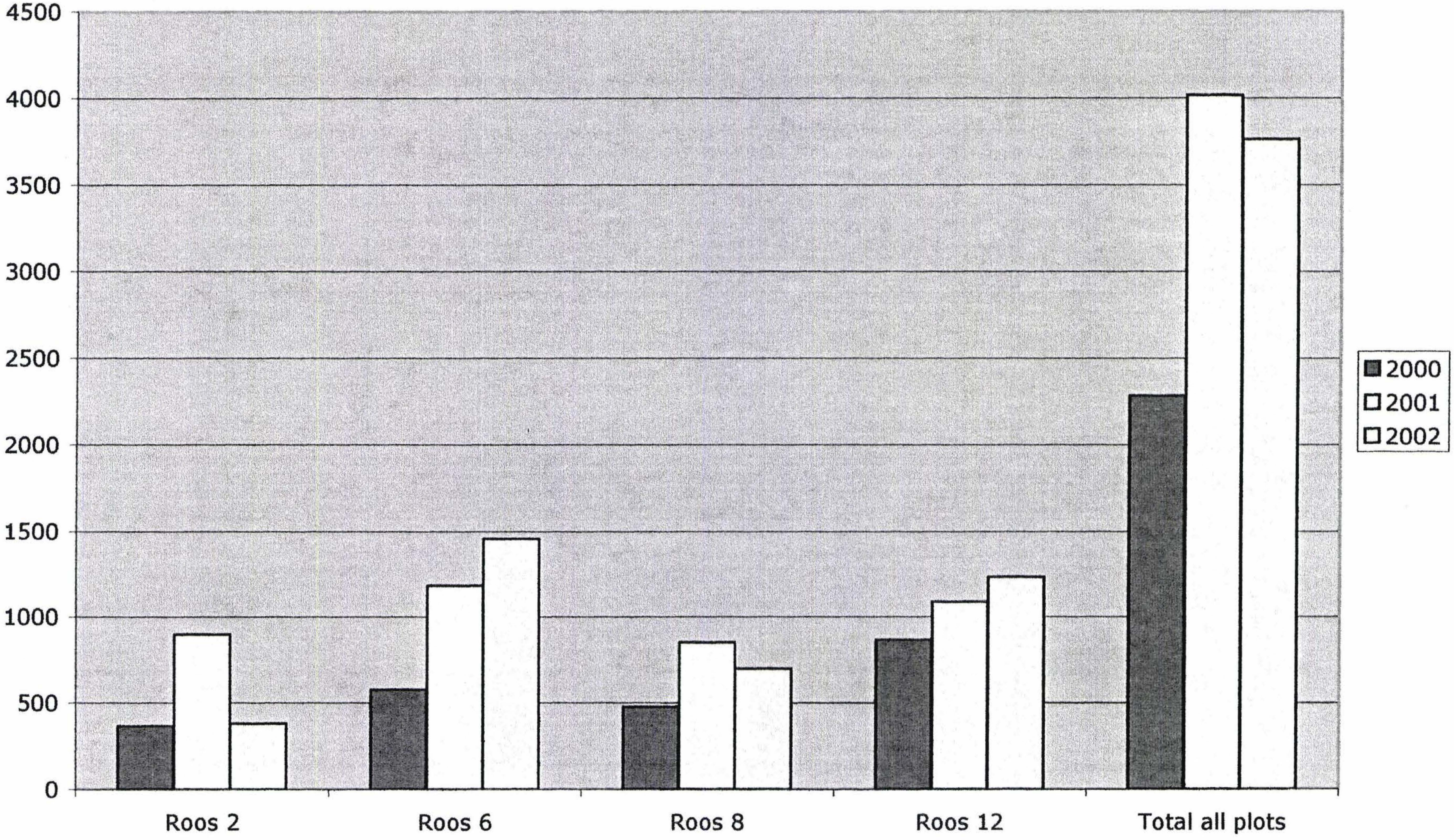


George Wright Crush 2000 to 2002
Perennial Grass Production (lbs./acre)

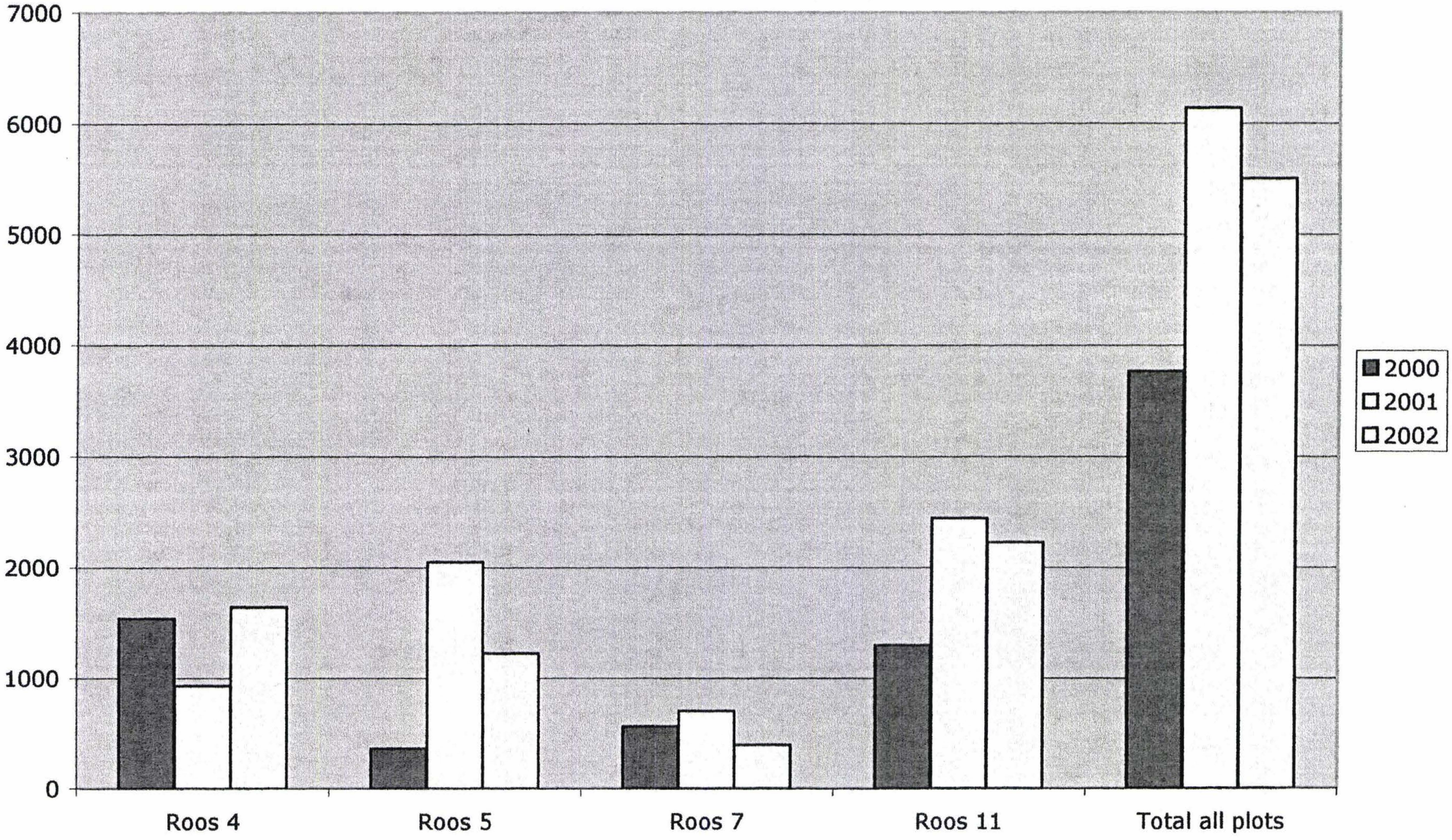
George Wright Crush/Seed 2000 to 2002
Perennial Grass Production (lbs./acre)



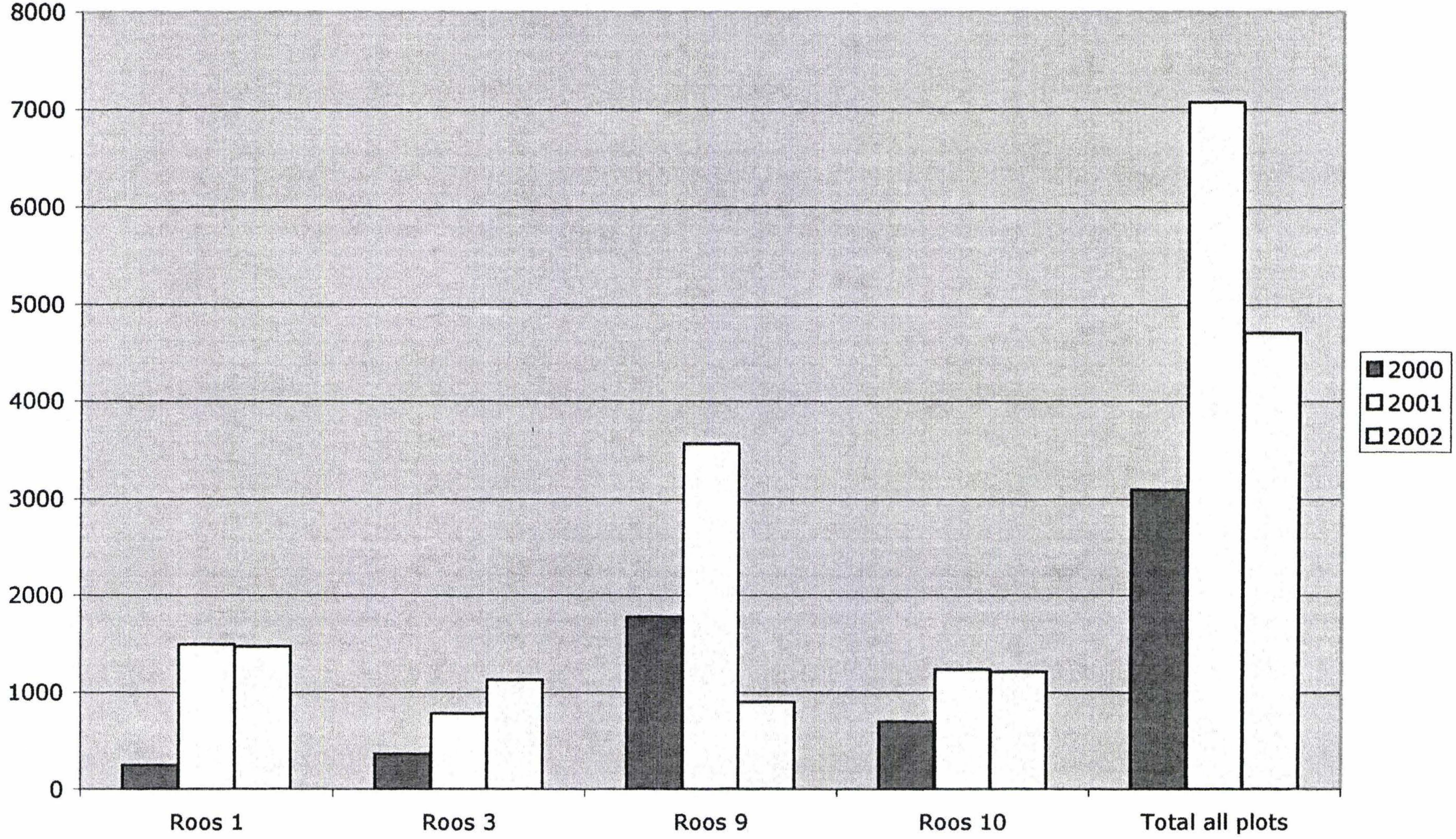
Roos Control 2000 to 2002
Total Annual Production (lbs./acre)



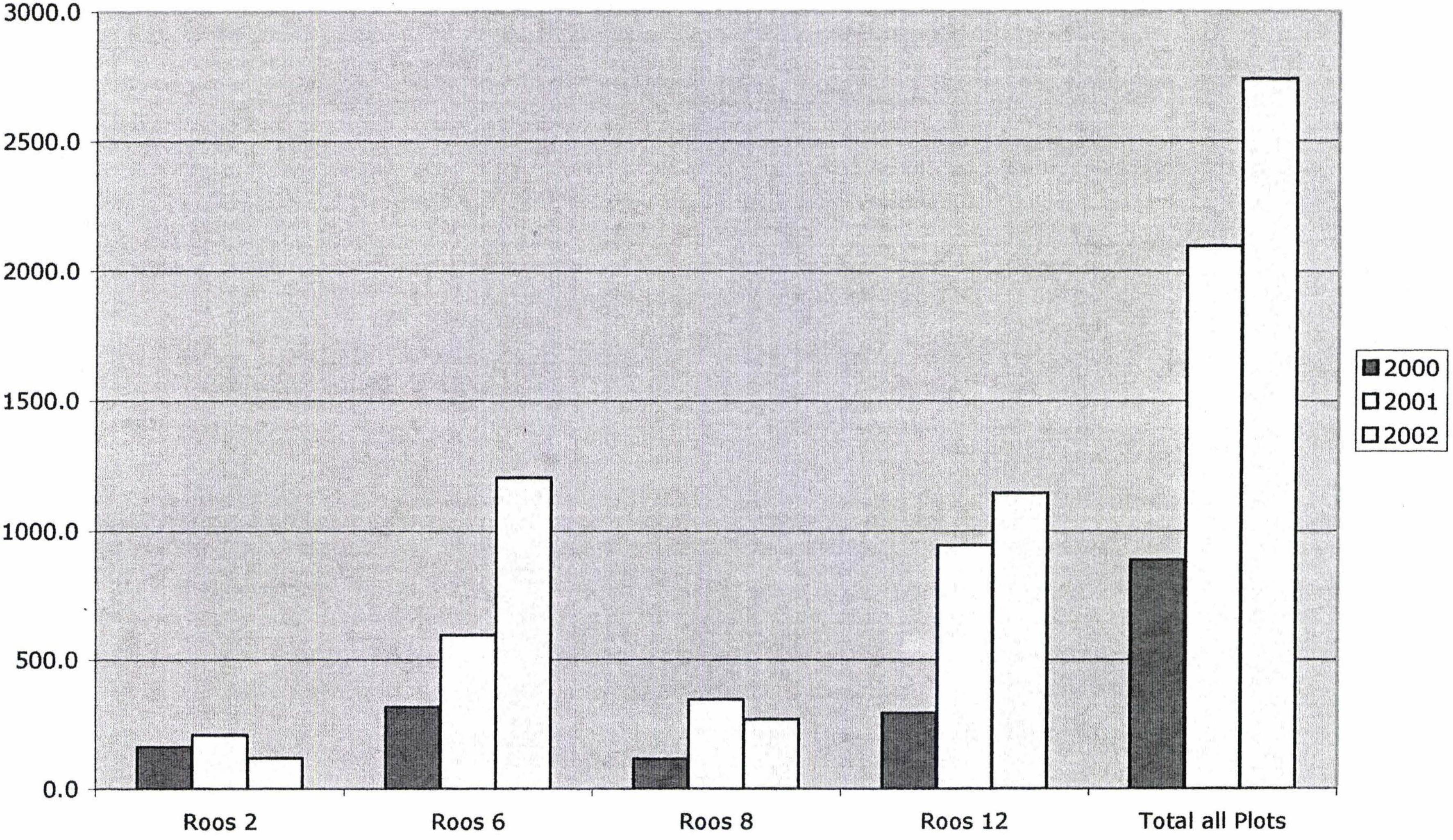
Roos Crush 2000 to 2002
Total Annual Production (lbs./acre)



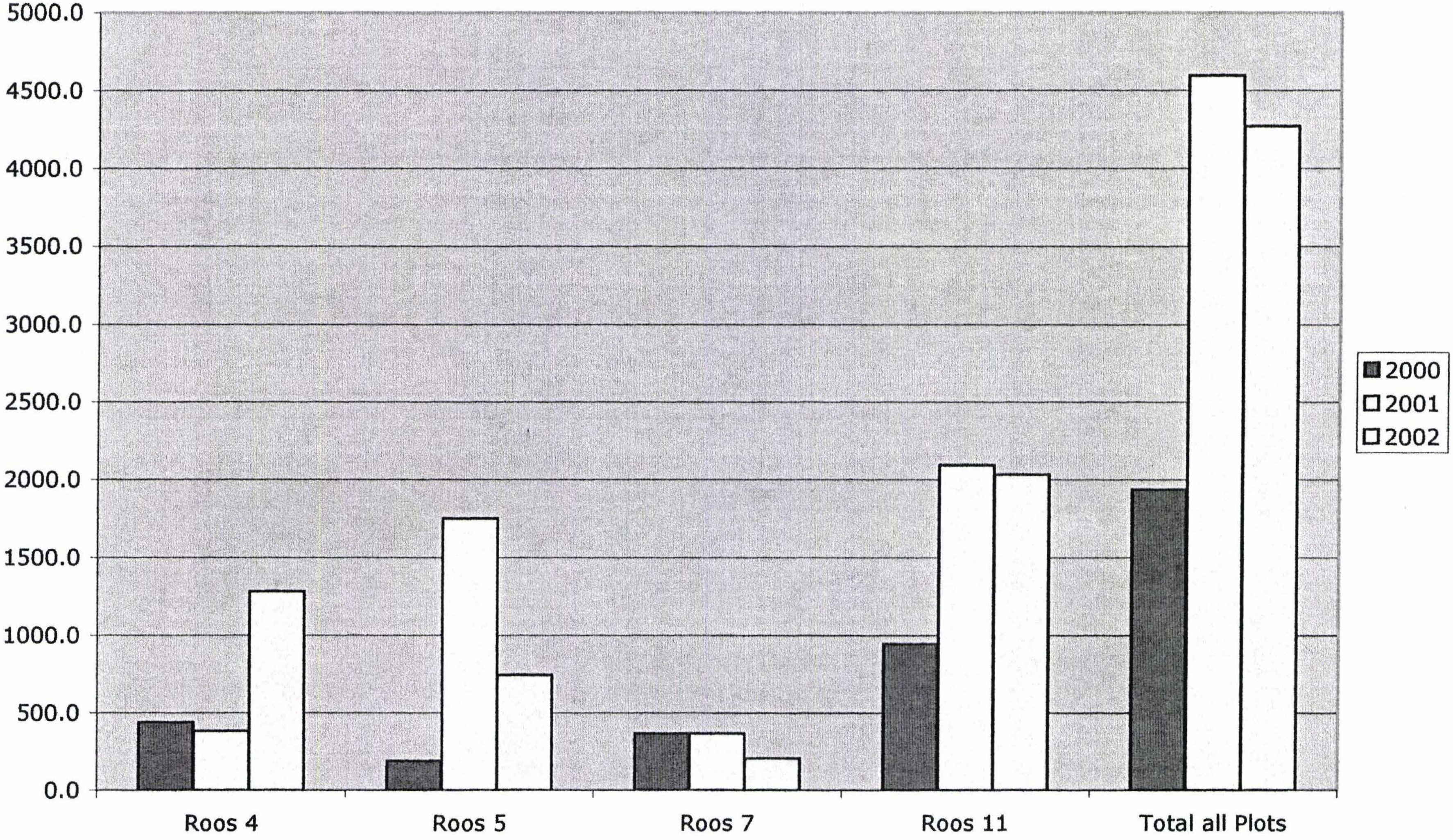
Roos Crush+Seed 2000 to 2002
Total Annual Production (lbs./acre)



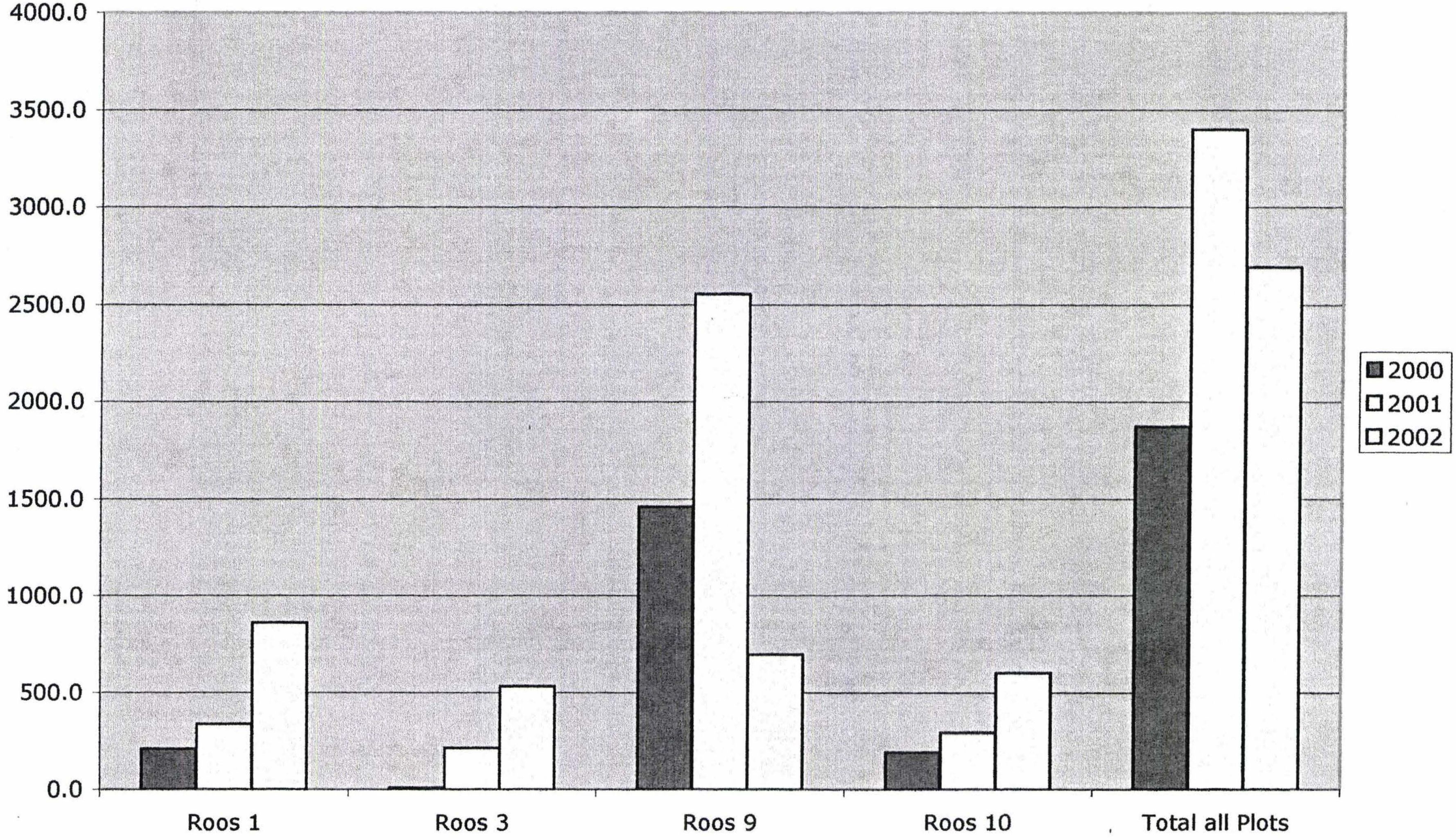
Roos Control 2000 to 2002
Perennial Grass Production (lbs./acre)



Roos Crush 2000 to 2002
Perennial Grass Production (lbs./acre)



Roos Crush/Seed 2000 to 2002
Perennial Grass Production (lbs./acre)



Precipitation Table

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January to January rainfall total.	15.18	10.92	10.42
Date production measurements completed.	11/25/00	10/23/01	12/7/02
Additional rain after data was collected.	0.03	0.92	0
Rainfall that occurred since last period of biomass measurements.	**15.15**	**10.03**	**11.34**
	Roos 2000	Roos 2001	Roos 2002
January to January rainfall total.	15.57	9.39	8.37
Date production measurements completed.	12/9/00	10/30/01	12/9/02
Additional rain after data was collected.	0.01	0.68	0
Rainfall that occurred since last period of biomass measurements.	**15.56**	**8.72**	**9.05**
	G. Wright 2000	G. Wright 2001	G. Wright 2002
January to January rainfall total.	7.82	7.13	8.35
Date production measurements completed.	12/9/00	10/12/01	11/21/02
Additional rain after data was collected.	0.15	0.71	0
Rainfall that occurred since last period of biomass measurements.	**7.67**	**6.57**	**9.06**

Total Annual Production Summary Table 2000 to 2002 (lbs./acre)

Plot	Treatment	2000 TAP	2001 TAP	2002 TAP
G. Wright 4	control	369	312	246
G. Wright 6	control	692	529	472
G. Wright 7	control	352	236	319
G. Wright 9	control	705	510	304
Total all plots		2118	1587	1341
G. Wright 2	crush	1828	1061	1107
G. Wright 3	crush	720	953	914
G. Wright 8	crush	1653	797	1295
G. Wright 11	crush	773	651	612
Total all plots		4974	3462	3928
G. Wright 1	crush/seed	1505	1457	667
G. Wright 5	crush/seed	438	378	714
G. Wright 10	crush/seed	1004	770	1386
G. Wright 12	crush/seed	464	811	327
Total all plots		3411	3416	3094
Glenn 1	control	170	119	1156
Glenn 4	control	0	0	488
Glenn 6	control	23	158	336
Glenn 11	control	611	673	297
Total all plots		804	950	2277
Glenn 2	crush	58	1004	558
Glenn 8	crush	190	242	366
Glenn 10	crush	518	623	607
Glenn 12	crush	615	752	635
Total all plots		1381	2621	2166
Glenn 3	crush/seed	972	1618	1106
Glenn 5	crush/seed	389	522	2066
Glenn 7	crush/seed	612	526	547
Glenn 9	crush/seed	265	469	1357
Total all plots		2238	3135	5076
Roos 2	control	365	898	380
Roos 6	control	576	1182	1456
Roos 8	control	478	850	697
Roos 12	control	864	1087	1231
Total all plots		2283	4017	3764
Roos 4	crush	1544	931	1645
Roos 5	crush	367	2052	1227
Roos 7	crush	562	704	397
Roos 11	crush	1298	2453	2236
Total all plots		3771	6140	5505
Roos 1	crush/seed	251	1494	1470
Roos 3	crush/seed	367	779	1131
Roos 9	crush/seed	1782	3566	897
Roos 10	crush/seed	694	1232	1212
Total all plots		3094	7071	4710

Perennial Grass Production Summary Table 2000 to 2002 (lbs./acre)

Plot	Treatment	2000 PG	2001 PG	2002 PG
G. Wright 4	control	317	172	187
G. Wright 6	control	654	344	384
G. Wright 7	control	300	128	256
G. Wright 9	control	546	342	176
Total all Plots		1817	987	1004
G. Wright 2	crush	1795	951	1009
G. Wright 3	crush	668	789	772
G. Wright 8	crush	1415	525	991
G. Wright 11	crush	571	429	549
Total all Plots		4449	2694	3321
G. Wright 1	crush/seed	1098	778	590
G. Wright 5	crush/seed	394	257	645
G. Wright 10	crush/seed	958	721	1453
G. Wright 12	crush/seed	414	685	260
Total all Plots		2864	2441	2949
Glenn 1	control	111	11	972
Glenn 4	control	0	0	313
Glenn 6	control	12	103	231
Glenn 11	control	460	416	186
Total all Plots		582	529	1701
Glenn 2	crush	17	184	266
Glenn 8	crush	130	81	159
Glenn 10	crush	160	335	319
Glenn 12	crush	482	349	458
Total all Plots		789	949	1201
Glenn 3	crush/seed	954	796	1036
Glenn 5	crush/seed	354	374	1820
Glenn 7	crush/seed	601	278	446
Glenn 9	crush/seed	119	308	895
Total all Plots		2028	1755	4197
Roos 2	control	161	207	119
Roos 6	control	316	597	1206
Roos 8	control	116	346	267
Roos 12	control	293	946	1147
Total all Plots		886	2096	2740
Roos 4	crush	439	382	1283
Roos 5	crush	191	1756	746
Roos 7	crush	367	365	208
Roos 11	crush	943	2095	2035
Total all Plots		1940	4597	4272
Roos 1	crush/seed	211	336	862
Roos 3	crush/seed	9	216	533
Roos 9	crush/seed	1460	2556	697
Roos 10	crush/seed	193	291	601
Total all Plots		1872	3399	2693

Production Estimates for Rocky Mountain Research Station Treatment Plots:

Glenn, Roos and George Wright
Year 2001

December 1, 2001

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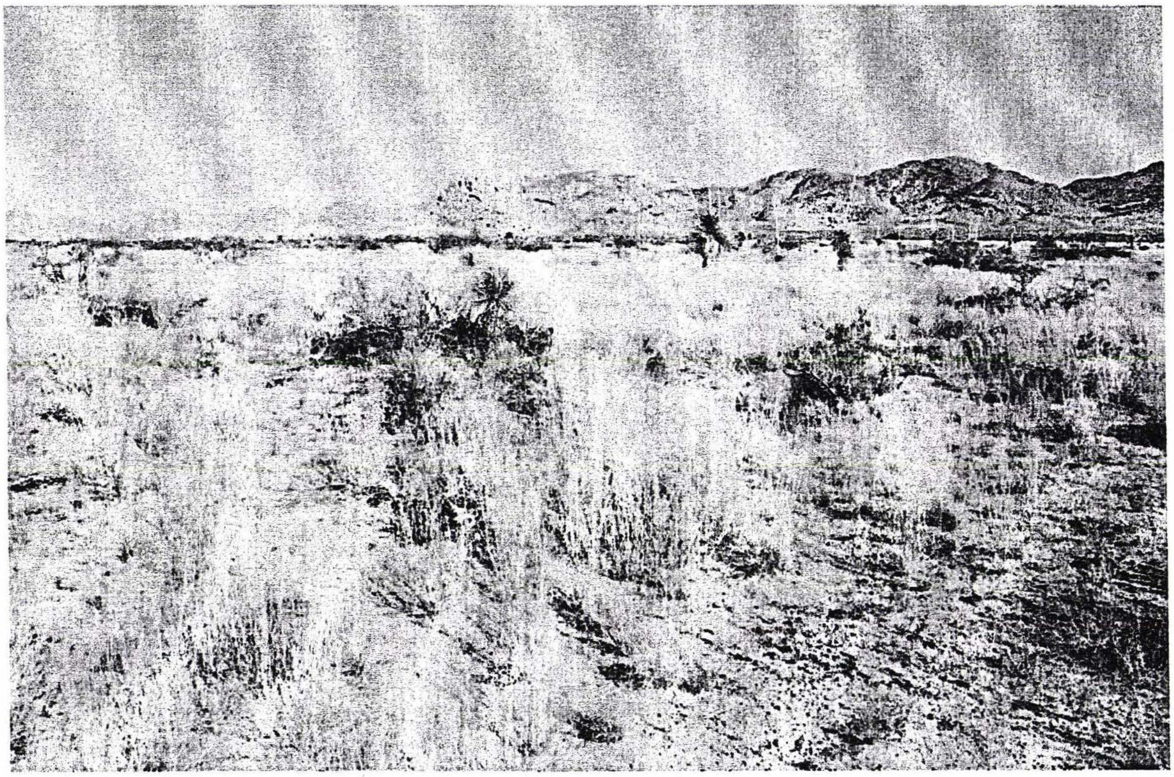

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Production Estimates for Roos, Glenn, Gray Treatment Plots
Year 2001

12/1/01

Introduction and Summary

This report provides year 2001 production estimates for 3 sites that received brush crushing treatments in 1999. The sites are: Glenn Ranch, Roos Ranch and George Wright pasture (Gray Ranch). Total Annual Production for the sum of all 36 plots (at the 3 sites) increased by 35% in 2001(Chart 1). Year 2000 produced 24,074 lbs./acre and 2001 produced 32,399. However, this overall increase was due to an extraordinarily productive year at the Roos plots. Production at the Roos nearly doubled from 9148 lb./acre in 2000 to 17,228 lbs./acre in 2001 (Chart 3). George Wright experienced a TAP decrease of 20%, going from 10,503 in 2000 to 8465 in 2001 (Chart 4). TAP at the Glenn plots increased from 4423 lbs./acre in 2000 to 6706 lbs./acre in 2001, an increase of 35% (Chart 5). These increases were largely due to higher production of annual forbs, grasses and sub-shrubs like burrobrush (*Isocoma tenusecta*). Additionally, the plots have excluded grazing for nearly 3 years. Therefore an overall increase in biomass could be expected even if no treatments took place. Most importantly, perennial grass production (PGP) for the sum of all 36 plots increased by 13% from 17,228 lbs./acre in year 2000 to 19,448 lbs./acre in 2001 (Chart 2). Once again, the extraordinary year at the Roos site was the primary cause for the overall increase. Therefore, it is important to look at each site individually, as will be done below.

The influence of precipitation on biomass production is paramount. It is the number one factor affecting plant growth in arid lands. This point is well illustrated when one compares TAP and rainfall between the 3 sites for the 2001 growing season. Despite the fact that precipitation data from the 3 weather stations located at each site is only available up until August 28th, 2001, the overall trend of the season can still be observed. During the period of time between June 1, 2001 and August 28th, 2001, the Roos site received 6 inches of rain. The Glenn's were blessed with 6.31 inches, but the poor ol' George Wright got a paltry 1.06 inches of rain. TAP values reflect this disparity of rain distribution. This decline in TAP at the George Wright emphasizes the importance of grazing exclosures. Despite the fact that no grazing has occurred at the George Wright for 3 years, it still experienced a decline in production because of drought. The effects of drought and grazing are virtually indistinguishable, and without a series of exclosures throughout the landscape it becomes difficult to distinguish between the two effects.

Methods

Biomass estimates were taken during the Fall of 2001 between the dates of 10/9/01 to 10/30/01 using SCS protocol (Form SCS-417) for determining production and composition. This double sampling method is described in detail in the National Handbook for Native Grazing Lands. Each treatment site contains twelve plots that measure 500 by 500 feet. One transect, consisting of ten 9.84 sq. ft. quadrats was placed in the center of each plot. Ten quadrats were sampled for herbaceous and non-woody shrub cover. Woody shrubs, such as creosote, mesquite and tarbush were not measured. Sub-shrubs, such as snakeweed and burrobrush were measured. A minimum of 2 out of the ten quadrats were clipped and weighed. Plant material averaged about 90% dry weight.

Production calculations were made using an Excel 97 spreadsheet program. This proved to be faster and more accurate as well as making the data easier to access for writing future reports. The raw data sheets, in addition to a computer disc, have been sent to Jerry Gottfried of the US Forest Service. Ron Bemis, of the NRCS Douglas Field Office, and the Malpai Borderlands Group also have discs containing the raw data and production calculations. Photo points were taken at each plot. The prints are located at the Malpai Group office.

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Photographic Points

Photographs were taken of each plot using a Canon Elan IIe 35mm camera. The lens used was a Tamron 28-200mm zoom lens at the 28mm setting in order to obtain the maximum field of view. Kodak Royal Gold 100 ISO print film was used, and the film was developed at Ferrari Color in Sacramento, California. A binder containing 36, 4x6 inch prints is at the Malpai Borderlands Group office.

One photograph was taken of each plot, for a total of twelve photos at each research site. Each photo was taken at the T-post marking each corner of the plot. The exact location for each plot is described below.

Glenn-

Photos taken from south corner of each plot looking 348 degrees magnetic. This aspect bisects the plot from one corner to the other.

Roos-

Photos taken from southwest corner of each plot looking 068 degrees magnetic. This aspect bisects the plot from one corner to the other.

George Wright-

Photos taken from southwest corner of each plot looking 062 degrees magnetic. This aspect bisects the plot from one corner to the other.

Discussion of what happened at each site

George Wright

Overall perennial grass production (PGP) was down by 33% at the whole site, with all three treatments showing a decline (Chart 6). The lack of rainfall during the 2001 growing season most likely contributes to the decrease in production, for the period from June 1, 2001 to October 31, 2001 yielded only 2.72 inches of rain. PGP in the control plots decreased by 46% and the crush plots declined by 40%. However, crush/seed declined by only 15%. It does not appear as though there is a significant difference in PGP between the crush treatment and the crush/seed.

Plains bristlegrass (*Setaria machrostachya* aka SEMA) and Lehmann's lovegrass (*Eragrostis lehmanni* aka ERLE) are the two dominant perennial grass species at the site. Plains bristlegrass, which was seeded after the initial crushing treatment, showed an overall decrease at the site. Lehmann's lovegrass, an alien invader, showed no significant measurable quantity in 2000. However, year 2001 saw a striking increase in the amount of Lehmann's throughout all treatments. Other perennial grasses which make up the remainder of PGP include: Rothrock grama (*Bouteloua rothrockii*), three awns (*Aristida spp.*), and bush muhly (*Muhlenbergia porterii*). It is important to note that even though increases and decreases of certain perennial grasses occurred, an overall decline of PGP was seen at the George Wright pasture. Because drought conditions dominated for most of the 2001 growing season, certain species, such as the more drought tolerant Lehmann's lovegrass, saw increases in production, yet others, such as plains bristlegrass, declined due to unfavorable environmental conditions. Although biomass of ERLE increased proportionately relative to its cohorts, its increase was not great in actual pounds per acre (Chart 7).

Control- (Chart 8)

All four control plots showed a substantial decrease in PGP from 2000 to 2001. The total PGP for all 4 control plots in year 2000 was 1817 lbs./acre. Year 2001 showed a 46% decrease in PGP to 987 lbs./acre. Plains bristlegrass (SEMA) constituted 9% of the PGP in 2000, but declined to only 3% in 2001. Lehmann's lovegrass (ERLE) appeared to take the place of plains bristlegrass in 2001. No measurable amount occurred in 2000, but in 2001 it was 9% of the total PGP. Other perennial grasses (named above) made up 91% of perennial grass biomass in 2000, and at 91% in 2001, they remained essentially unchanged.

Crush- (Chart 9)

Three out of four crush plots showed a decrease in PGP from 2000 to 2001. The total PGP for all 4 crush plots in year 2000 was 4449 lbs./acre. Year 2001 PGP decreased to 2695 lbs./acre, a drop of 40%. 73% of PGP in 2000 was composed of SEMA. This figure dropped to 29% in 2001. This loss of production was partly filled in by ERLE, which only accounted for 1% of PGP in 2000, but increased to 11% in 2001. Other perennial grasses experienced a 34% increase in production, going from 26% to 60% of total PGP.

Crush/Seed- (Chart 10)

Three out of four plots experienced a decline in PGP from 2000 to 2001. However, the decrease in production was not as dramatic as in the control and crush plots. Year 2000 PGP was 2864 lbs./acre. Year 2001 declined by 15% to 2441 lbs./acre. However, SEMA, the planted species, increased from being 26% of the total PGP to 29%. ERLE, which had no measurable biomass in 2000, increased to 21% of the total PGP in 2001. Other perennial grasses decreased from 74% to 50%.

Glenn

6.31 inches of rain fell between the dates of June 1, 2001 to August 28, 2001. This was an average rainfall year and it appears as though no dramatic changes in the plots occurred, although a slight increase in plains bristlegrass occurred in the crush plots. The crush/seed treatments have nearly double the PGP of the crush treatments.

Control- (Chart 13)

No clear trend can be observed in the Glenn control plots. The 9% decrease in PGP from 2000 to 2001 is not a significant amount given the fact that the decrease was only 50 lbs./acre. Plot 4 had 0 lb. of production for the second year in a row. Plot 1 went from 111 lbs./acre in year 2000 to 11 lbs./acre in 2001, while plot 6 had the opposite effect of going from 12 lbs./acre in 2000 to 103 lb. Acre in 2001. Plot 11 had a disproportionately high production of 416 lbs./acre in 2001 relative to the rest. All perennial grass present on the plot was composed of tobosa (*Hilaria mutica*), Rothrock grama (*Bouteloua rothrockii*), three awns (*Aristida spp.*), and bush muhly (*Muhlenbergia porterii*).

Crush- (Chart 14)

Two out of four plots showed an increase in PGP. The combined increase was 20%, going from 789 lbs./acre to 949 lbs./acre. Plains bristlegrass comprised 19% of the total PGP in 2001. In 2000 it only comprised 3% of the total PGP. Assorted short lived perennial grasses e.g. Rothrock grama made up the remaining 81% of perennial grass biomass.

Crush/Seed- (Chart 15)

A slight drop from 2028 lbs./acre in year 2000 to 1756 lbs./acre in 2001 occurred. This 13% reduction is not a significant amount, for species composition was mostly unchanged. SEMA comprised 73% of total PGP in 2000 and 68% in 2001. Sideoats grama (*Bouteloua curtipendula*) was not measured in any significant quantity in 2001. In 2000 it comprised 3% of the total PGP.

Roos

Year 2001 saw a substantial increase in PGP at the Roos site (Chart 16). 6 inches of rain fell between the dates of June 1, 2001 to August 28, 2001 making for a decent year's growth in the sandy soils of the Rodeo region. The crush plots appear to have more PGP than the crush/seed plots. The increase in PGP is largely attributable to a sharp increase in Lehmann's lovegrass. Plains bristlegrass declined in all treatments(Chart 17). This does not appear to be a feature of drought, but rather of increased competition from Lehmann's lovegrass.

Control- (Chart 18)

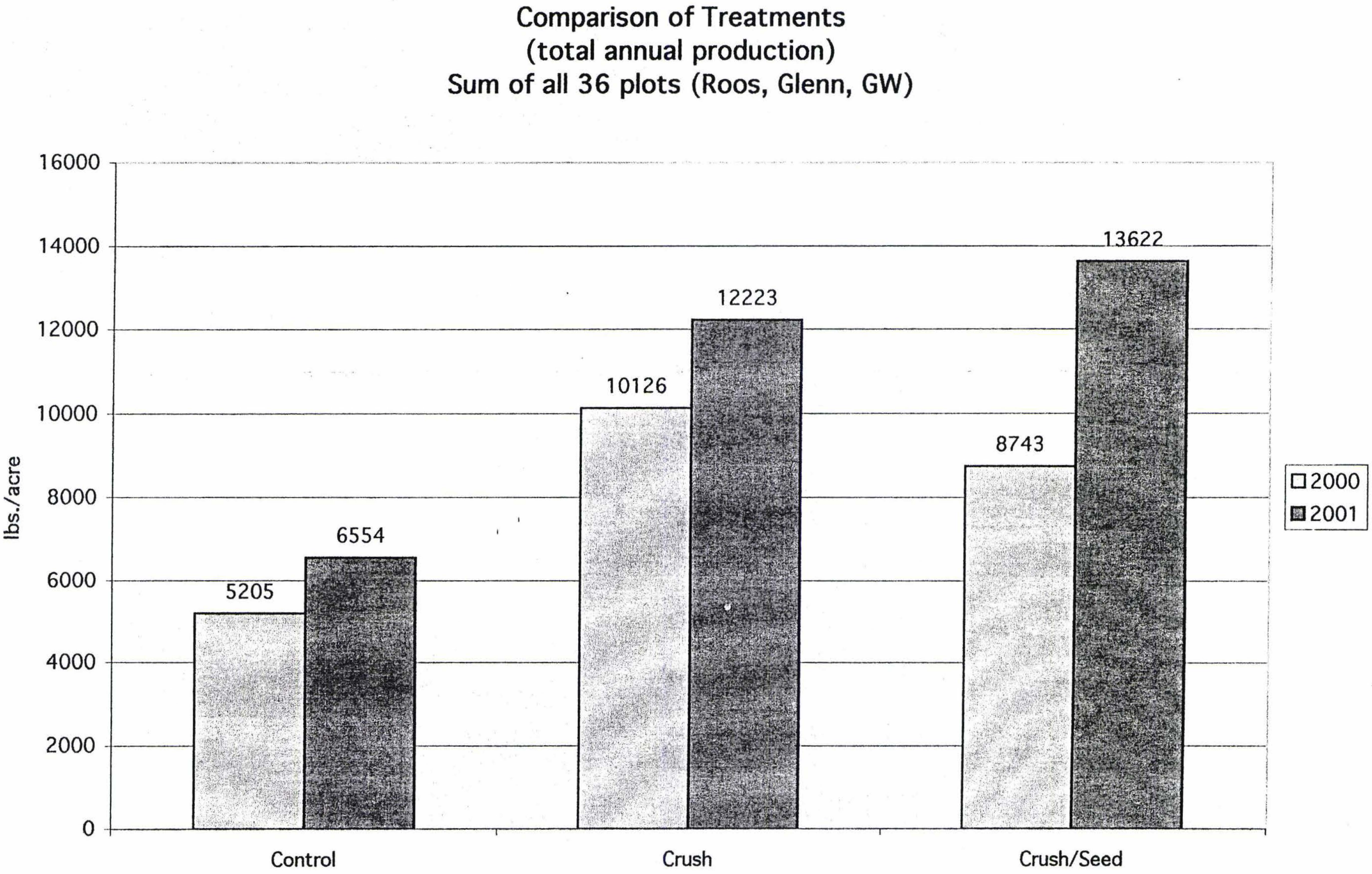
All four plots showed an increase in PGP from year 2000 to 2001, going from 886 lbs./acre to 2096 lbs./acre respectively. Species composition remained almost the same, although a slight decrease in SEMA occurred (-7%). In 2000 SEMA comprised 15% of the PGP but decreased to 6% in 2001. ERLE was essentially unchanged, going from 44% in 2000 to 46% in 2001. Other perennial grasses, such as bush muhly, dropseed (*Sporobolus spp.*), and three-awns comprised 48% of the PGP in 2001

Crush- (Chart 19)

PGP production in the crush plots more than doubled from 2000 to 2001. Year 2000 PGP was 1940 lbs./acre and year 2001 measured 4597 lbs./acre. Unfortunately, SEMA declined in biomass while ERLE increased. ERLE was 54% of the total PGP in 2000 but had increased to 73% in 2001. SEMA comprised 25% of the total PGP in 2000 but declined to 14% in 2001. Other perennial grasses constituted 13% of PGP in 2001.

Crush/Seed- (Chart 20)

PGP in these plots nearly doubled in 2001, going from 1872 lbs./acre in 2000 to 3399 lbs./acre in 2001. Again, ERLE increased in composition while SEMA decreased. In 2000 ERLE totaled only 14% of PGP, but had increased to 32% of the total PGP in 2001. SEMA comprised 75% of the PGP in 2000 but was reduced to 47% in 2001. Other perennial grasses totaled 11% of the species composition.



Comparison of Treatments
(total annual production)
Sum of all 36 plots (Roos, Glenn, GW)

Chart 1

Comparison of Treatments
(perennial grass biomass)
Sum of all 36 plots (Roos, Glenn, GW)

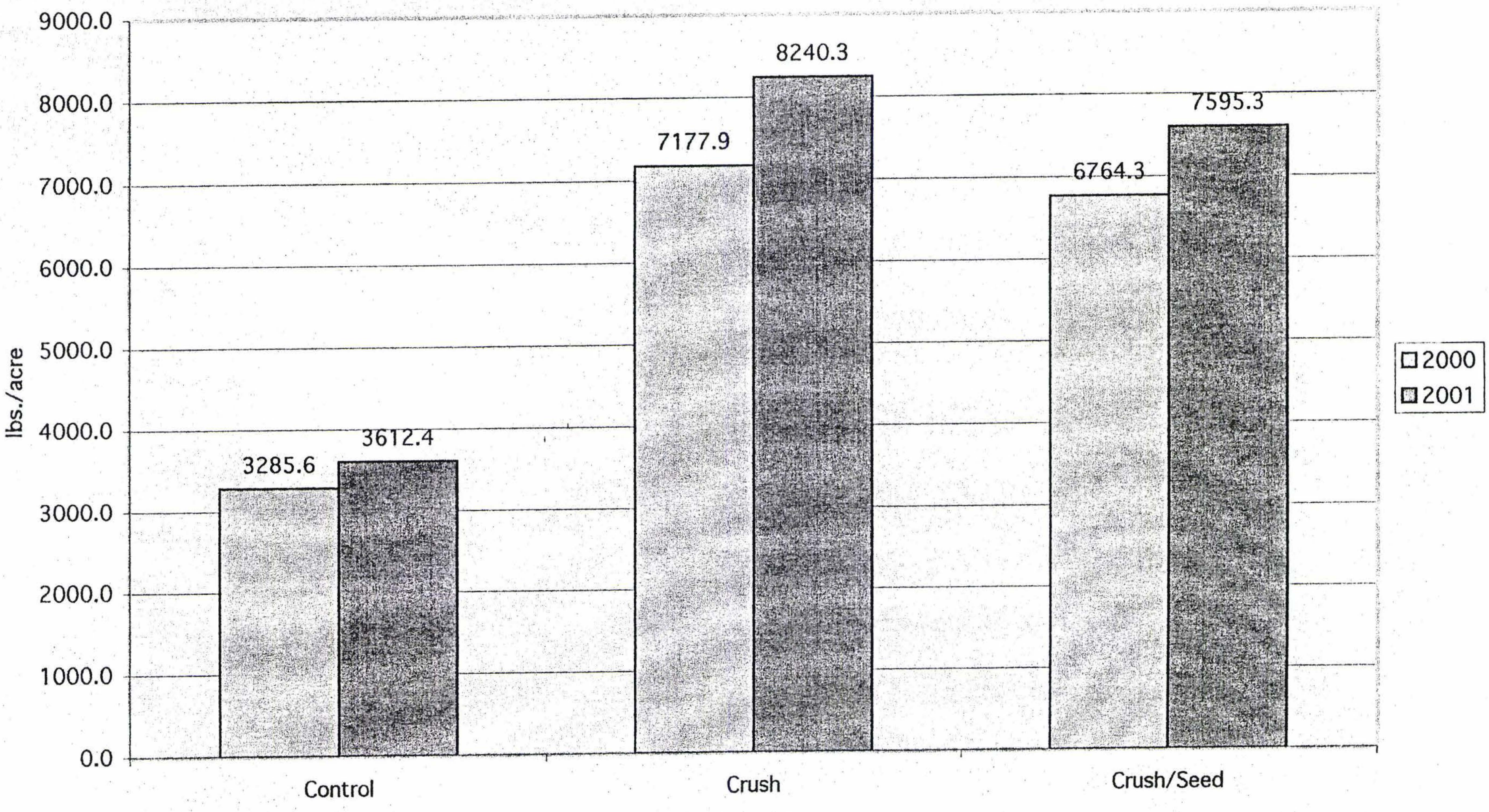


Chart 2

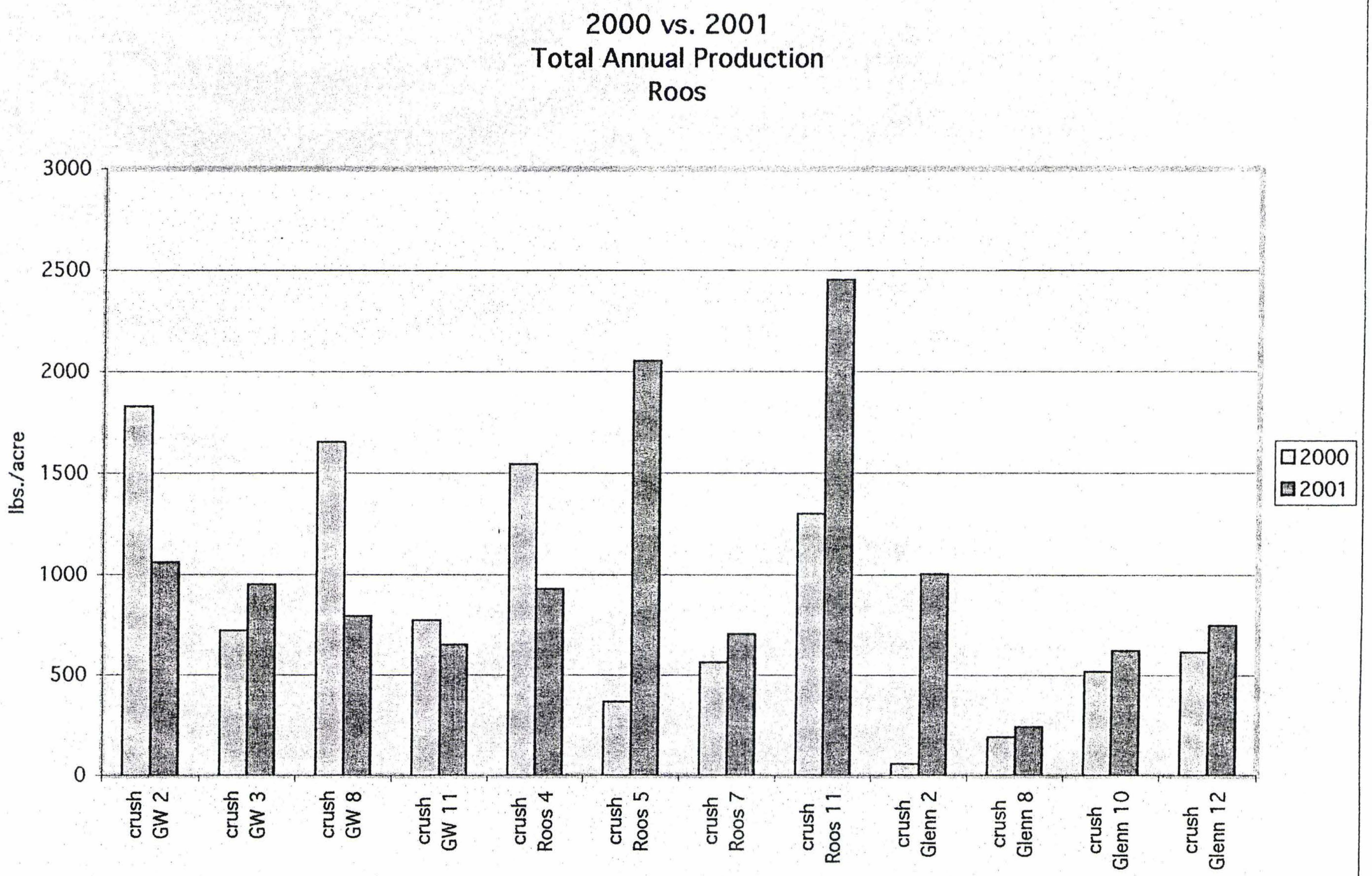

2000 vs. 2001
Total Annual Production
Roos
3000
2500
2000
1500
1000
500
0
lbs./acre
crush GW 2
crush GW 3
crush GW 8
crush GW 11
crush Roos 4
crush Roos 5
crush Roos 7
crush Roos 11
crush Glenn 2
crush Glenn 8
crush Glenn 10
crush Glenn 12
□2000
▨2001

Chart 3

2000 vs. 2001
Total Annual Production
George Wright Pasture

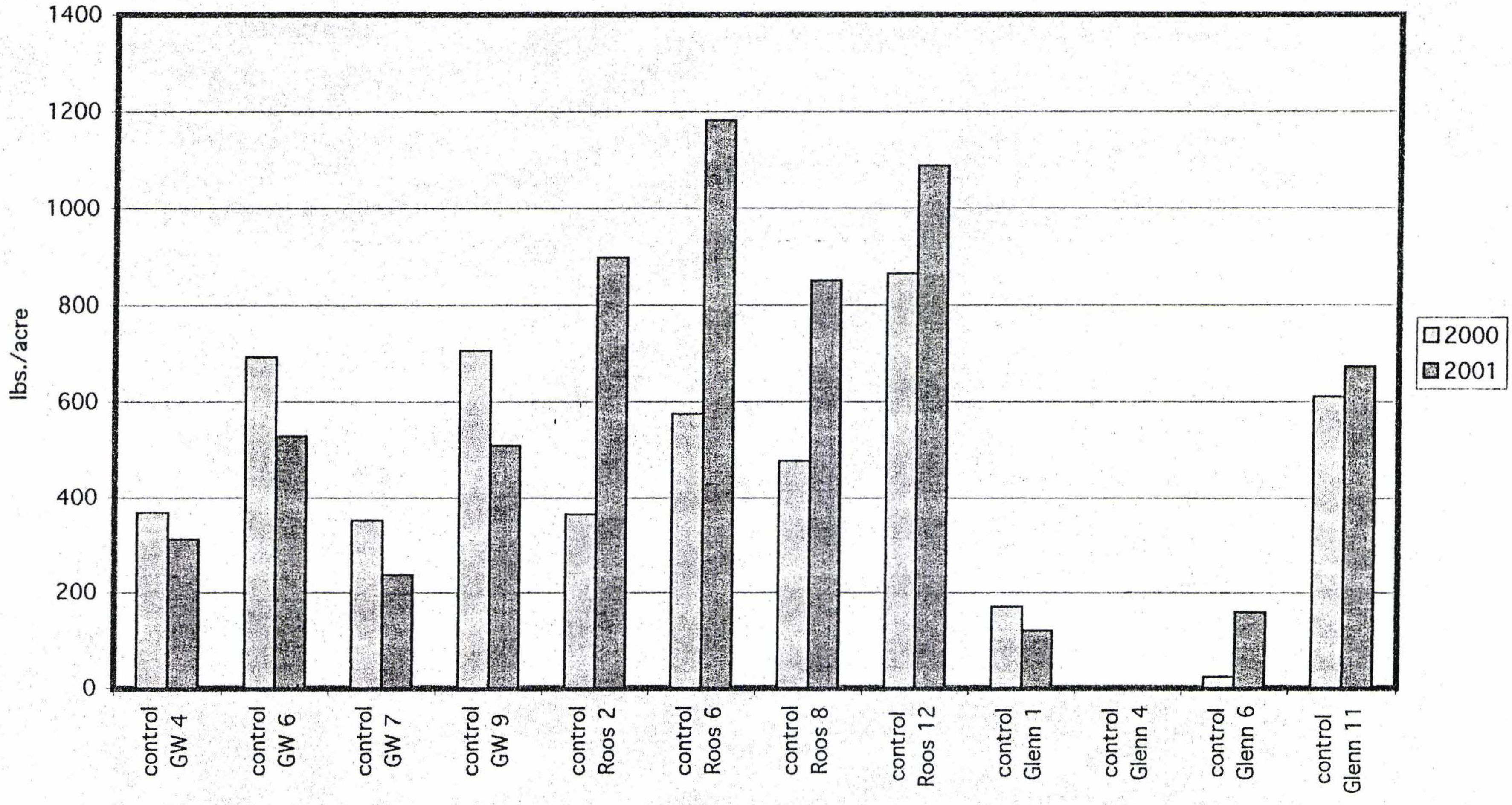


Chart 4

2000 vs. 2001
Total Annual Production
Glenn

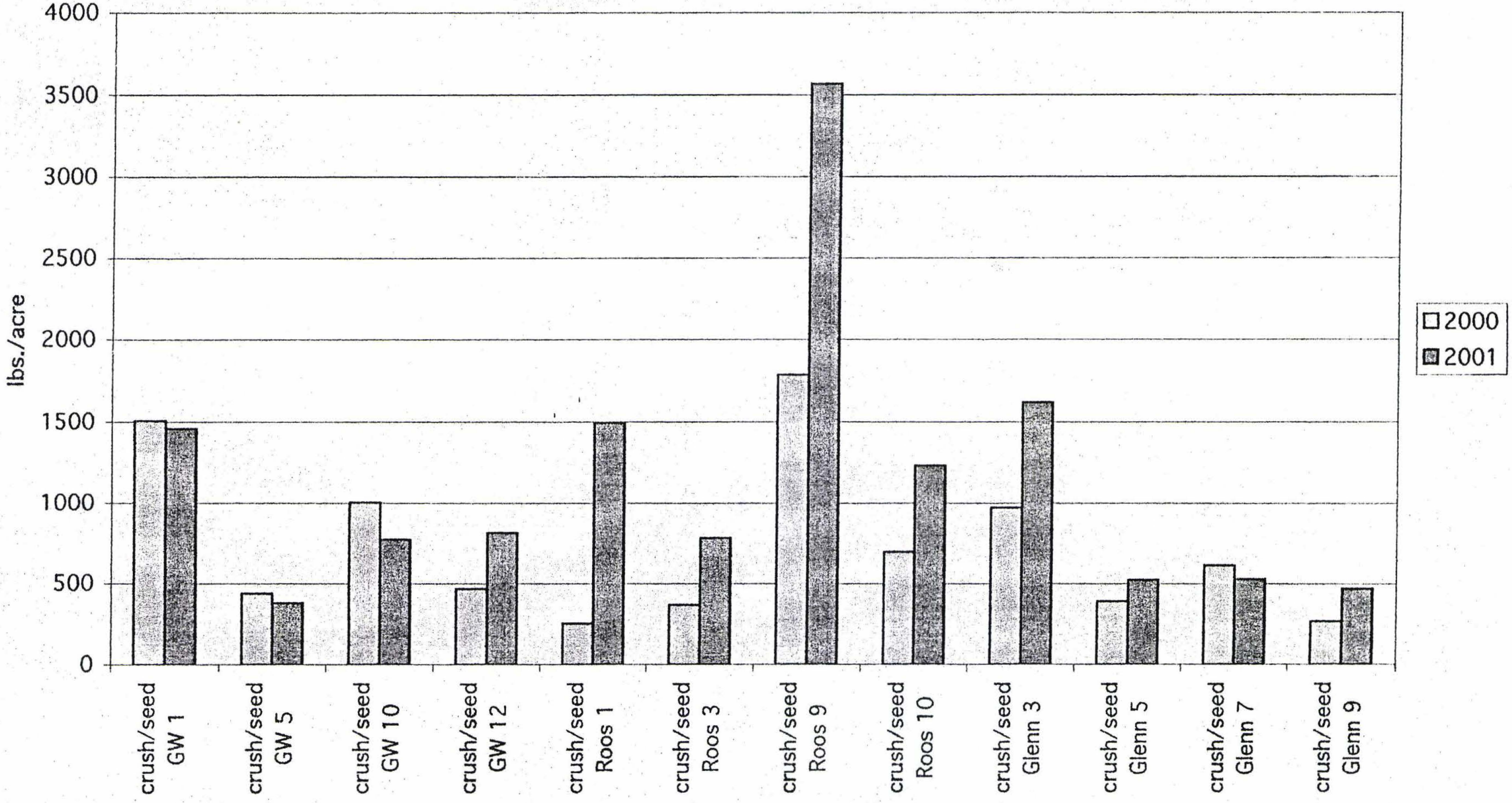


Chart 5

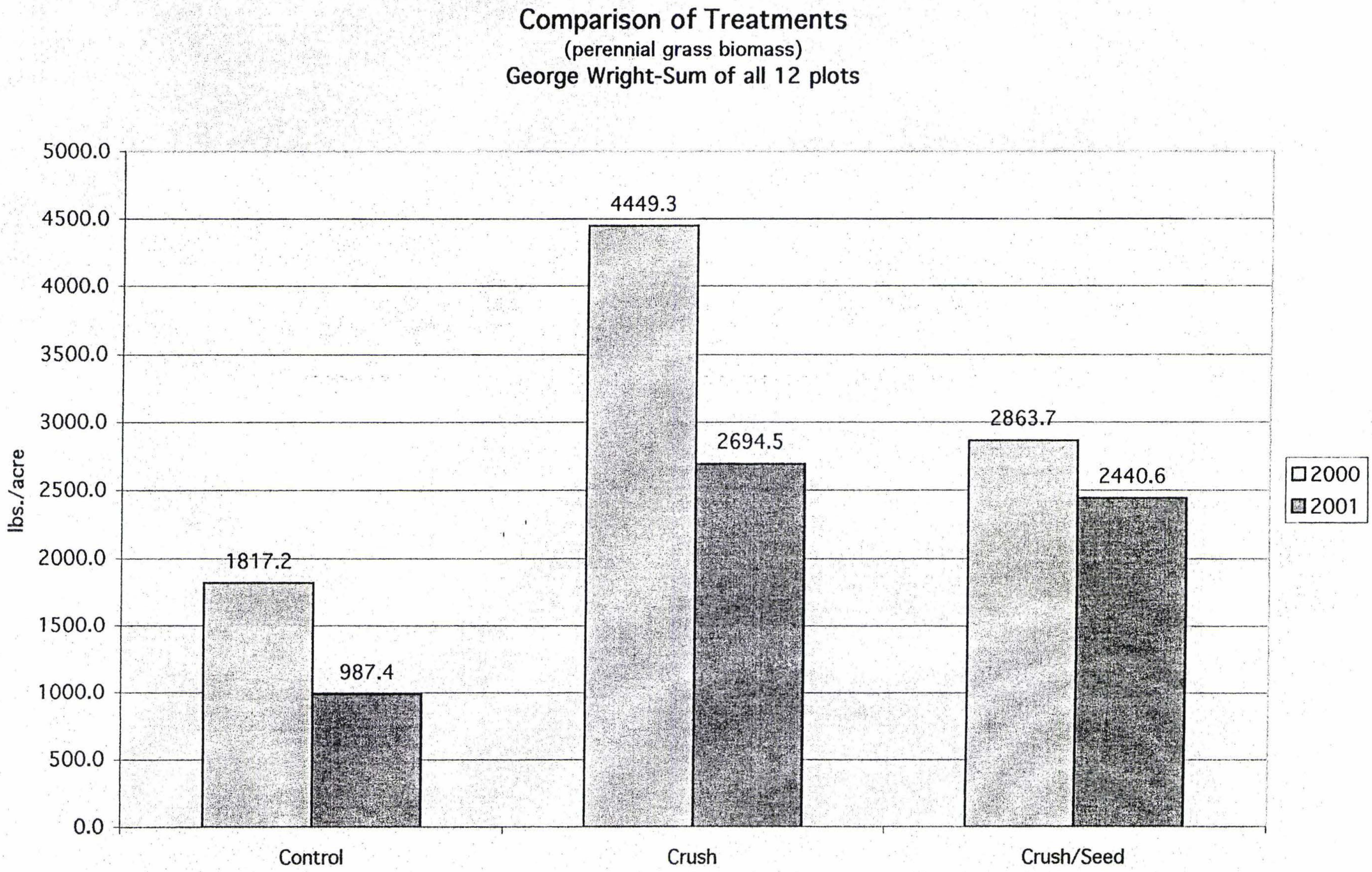

Comparison of Treatments
(perennial grass biomass)
George Wright-Sum of all 12 plots
lbs./acre
5000.0
4500.0
4000.0
3500.0
3000.0
2500.0
2000.0
1500.0
1000.0
500.0
0.0
1817.2
987.4
4449.3
2694.5
2863.7
2440.6
Control
Crush
Crush/Seed
□2000
▨2001

Chart 6

Percent Contribution to Perennial Grass Production
George Wright-2001

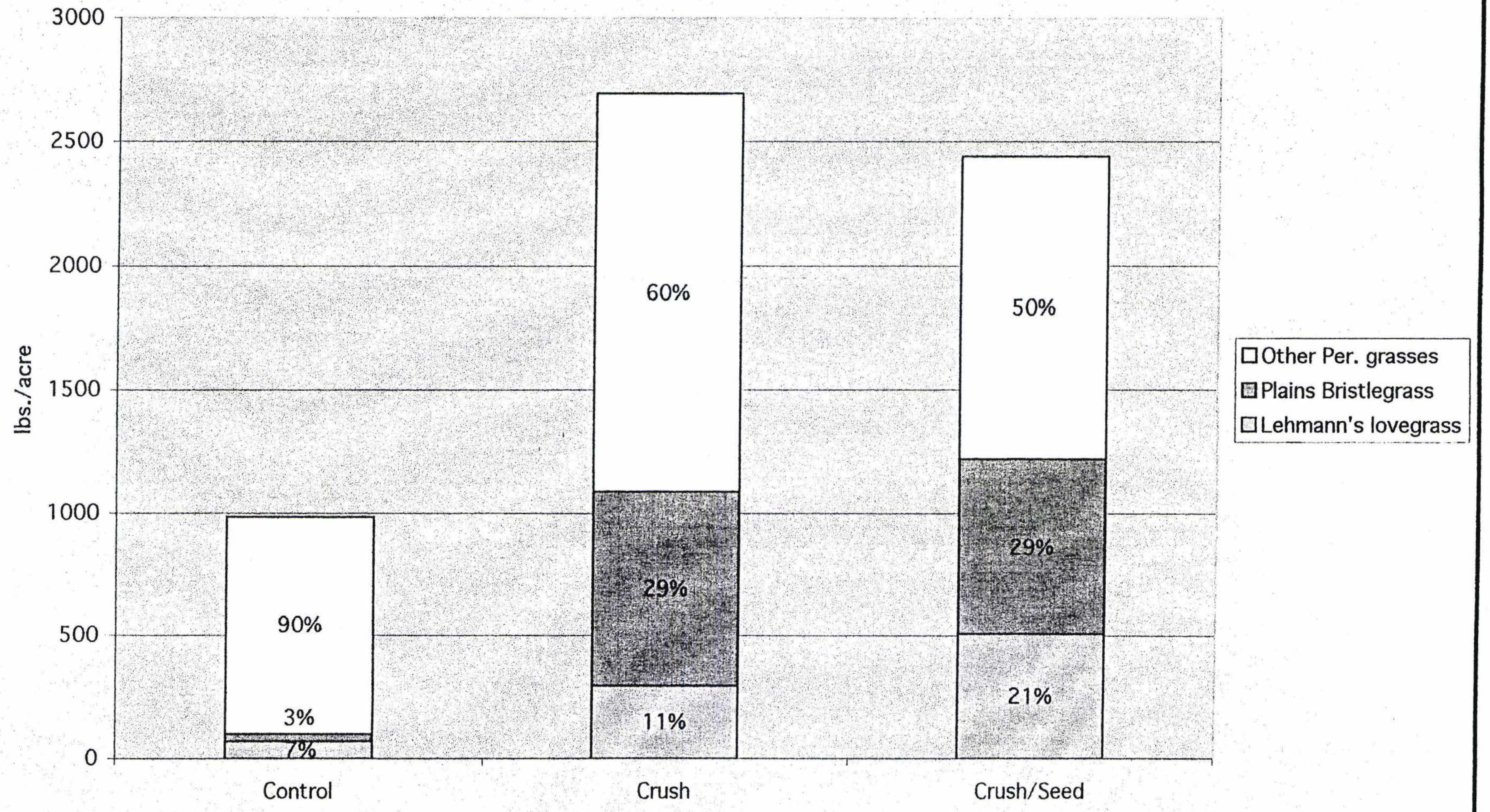


Chart 7

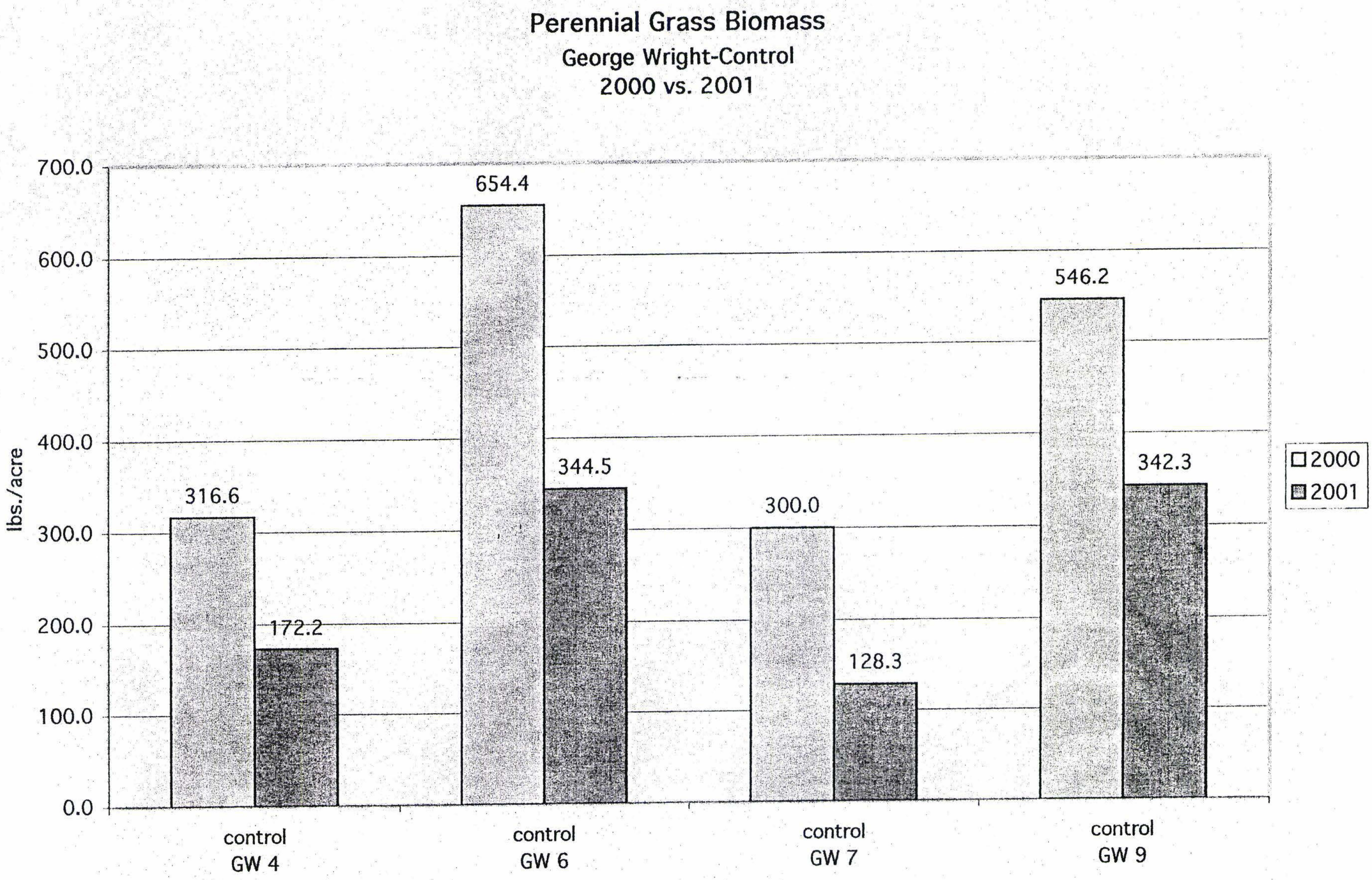

Perennial Grass Biomass
George Wright-Control
2000 vs. 2001
lbs./acre
700.0
600.0
500.0
400.0
300.0
200.0
100.0
0.0
654.4
546.2
344.5
342.3
316.6
300.0
172.2
128.3
control GW 4
control GW 6
control GW 7
control GW 9
□ 2000
▨ 2001

Chart 8

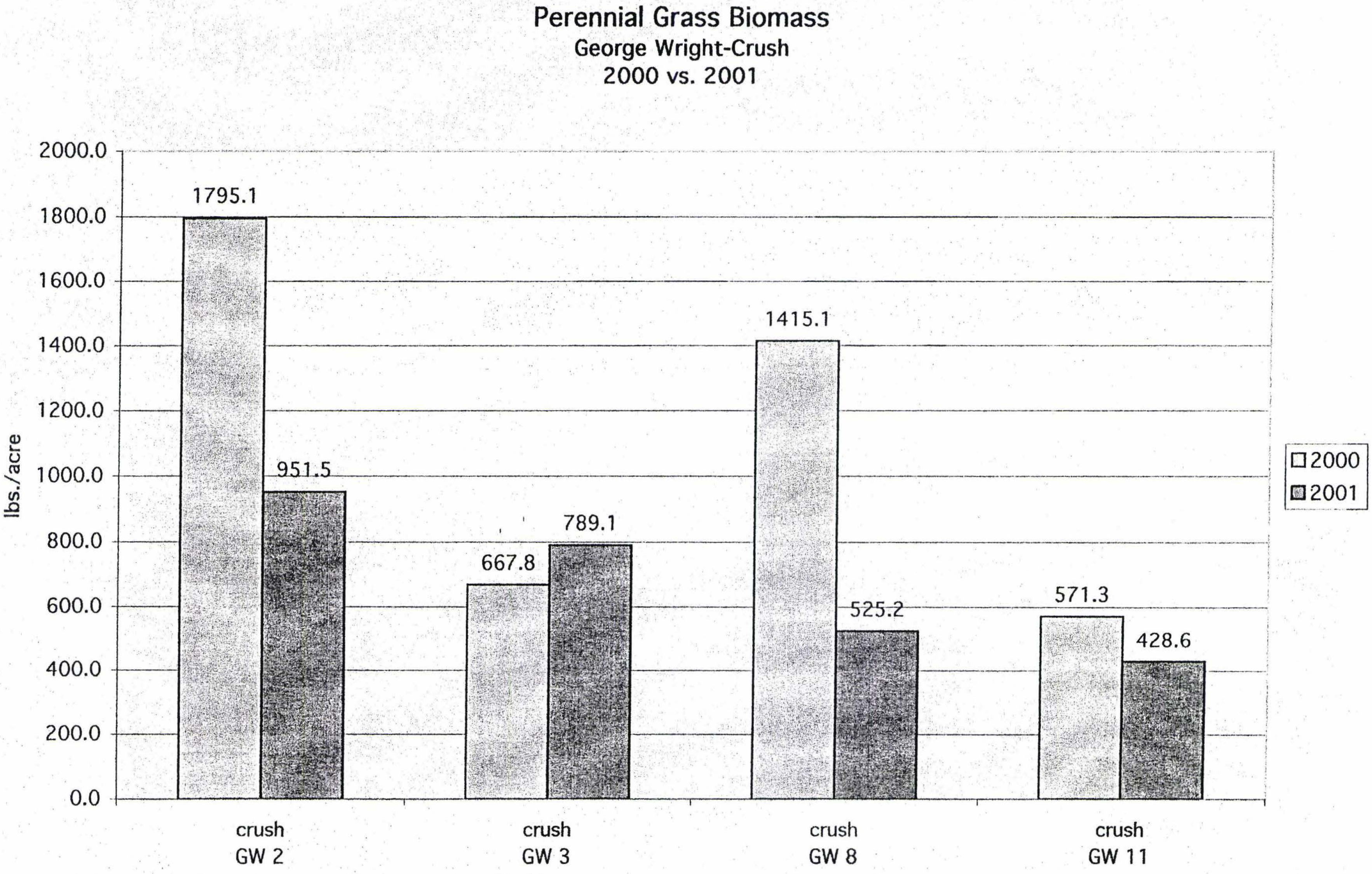
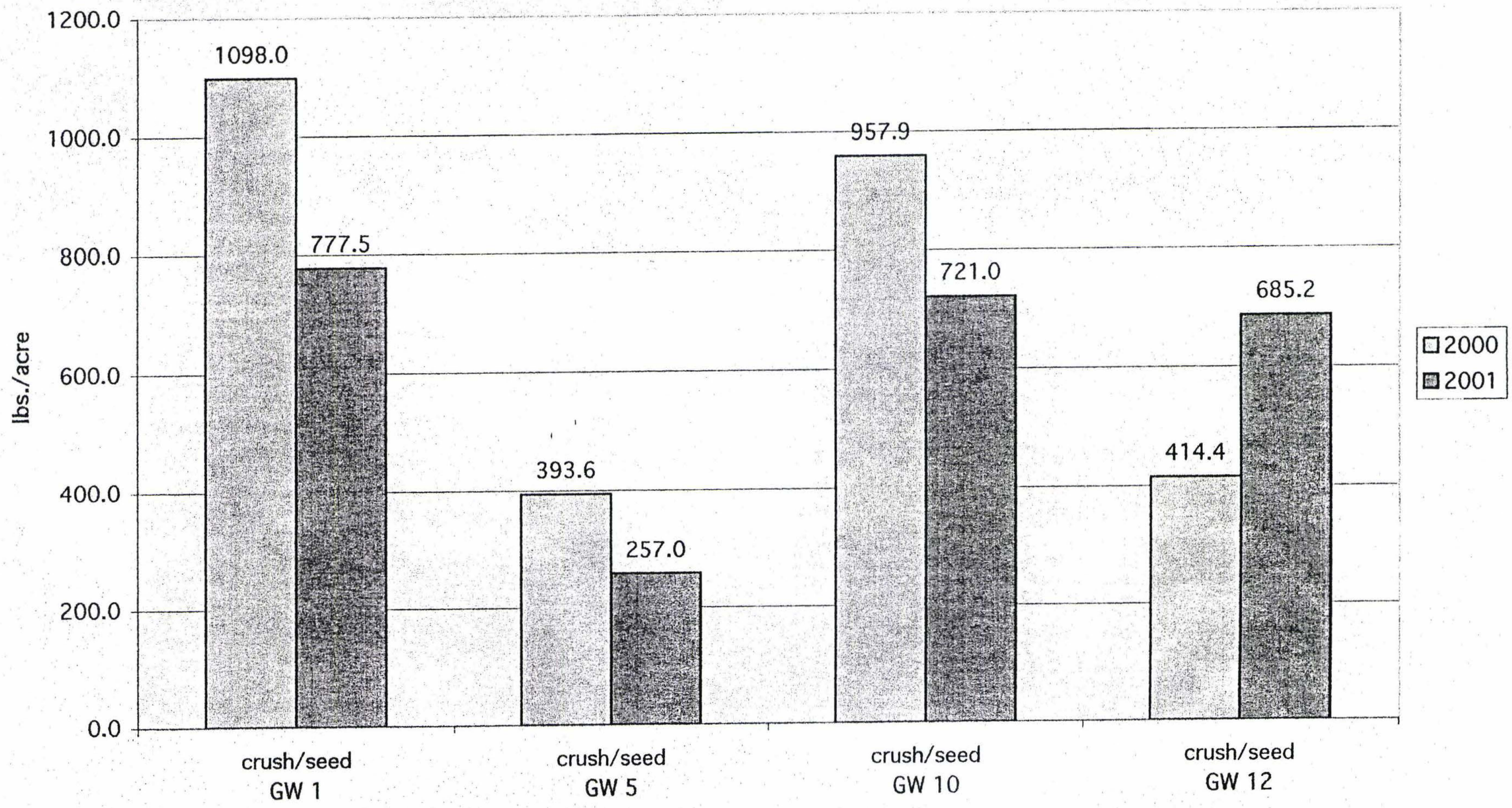
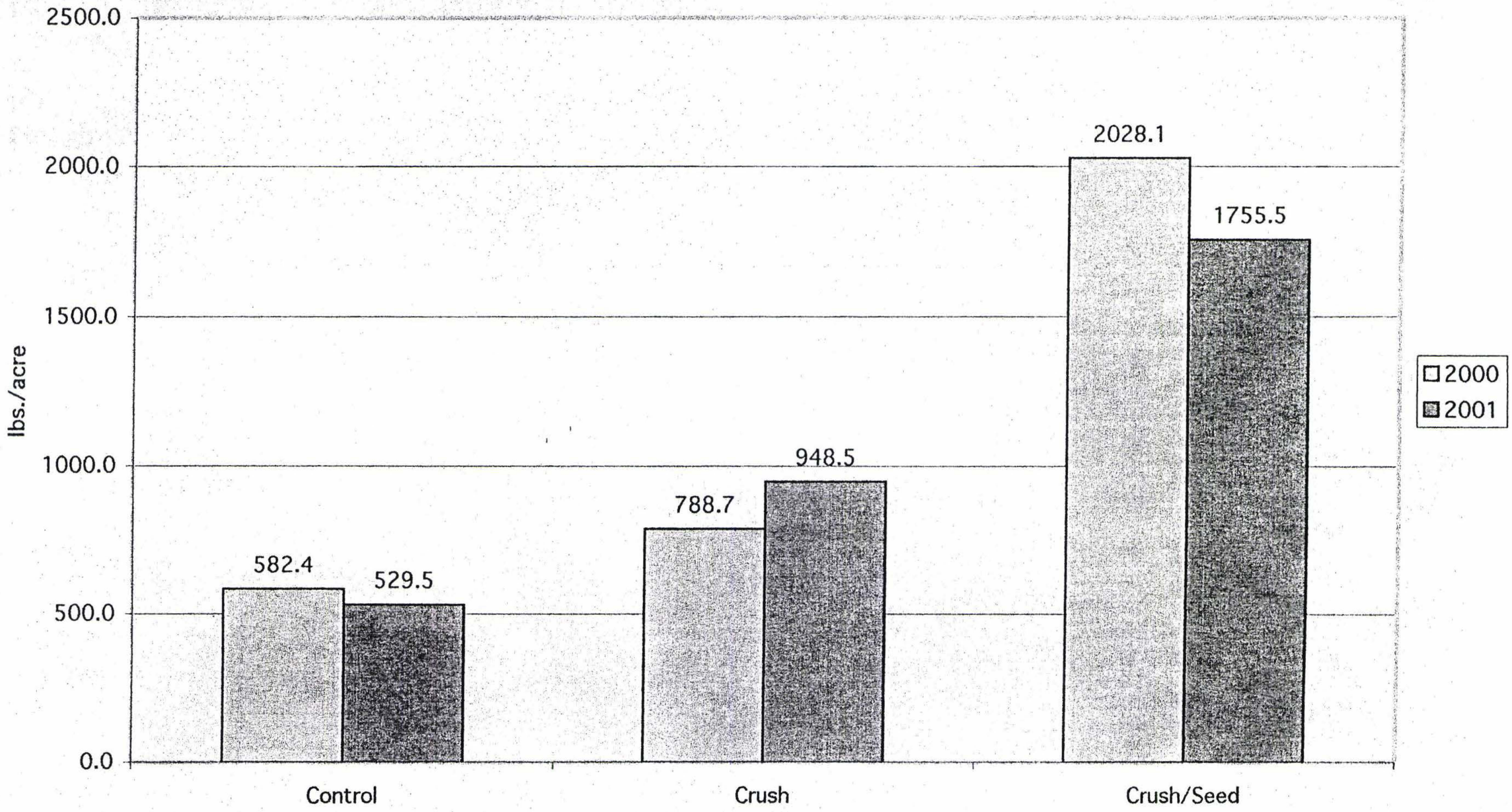

Perennial Grass Biomass
George Wright-Crush
2000 vs. 2001
lbs./acre
2000.0
1800.0
1600.0
1400.0
1200.0
1000.0
800.0
600.0
400.0
200.0
0.0
1795.1
951.5
667.8
789.1
1415.1
525.2
571.3
428.6
crush GW 2
crush GW 3
crush GW 8
crush GW 11
□ 2000
▨ 2001

Chart 9



Perennial Grass Biomass
George Wright-Crush/Seed
2000 vs. 2001

Chart 10



Comparison of Treatments
(perennial grass biomass)
Glenn-Sum of all plots

Chart 11

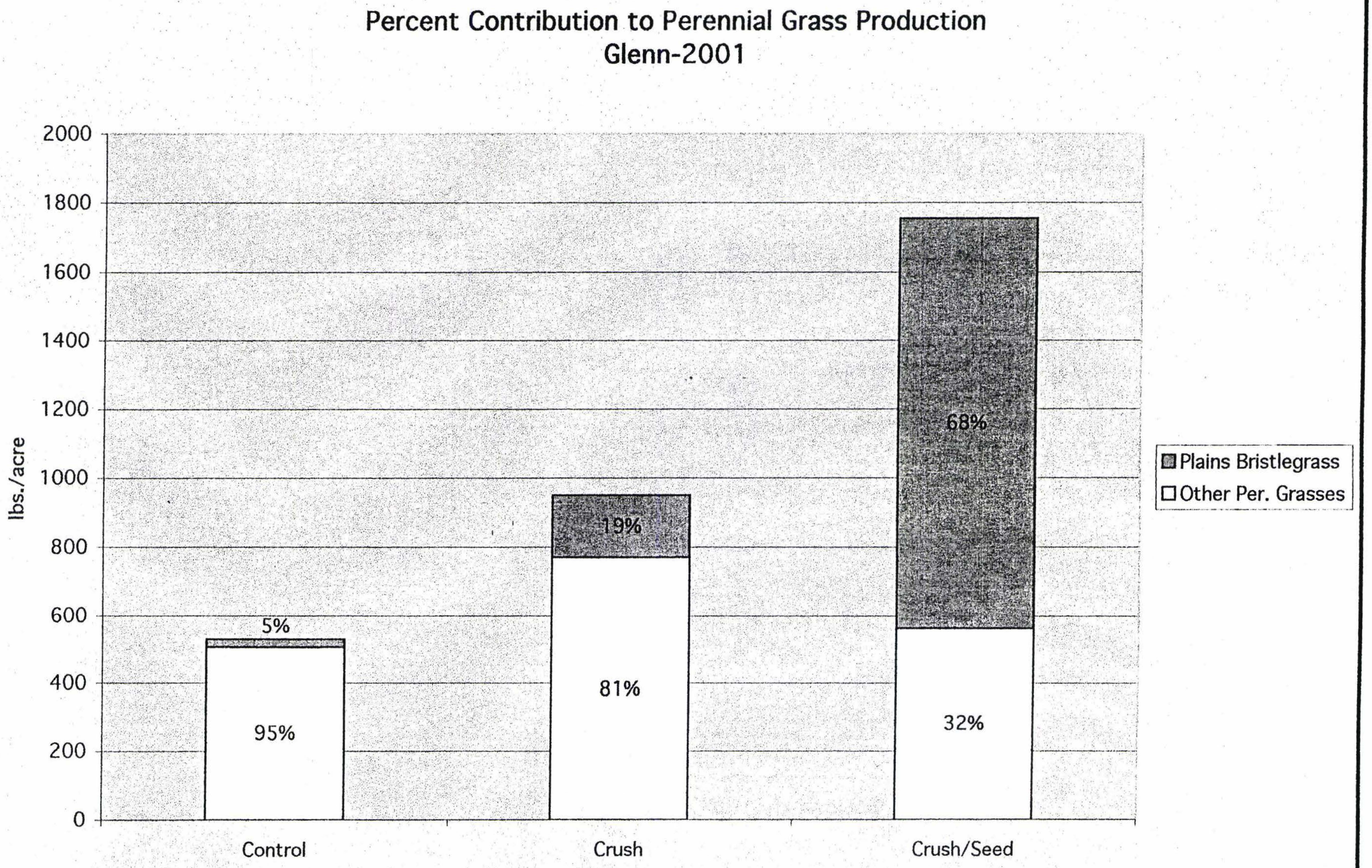

Percent Contribution to Perennial Grass Production
Glenn-2001
2000
1800
1600
1400
1200
1000
800
600
400
200
0
lbs./acre
5%
95%
19%
81%
68%
32%
Control
Crush
Crush/Seed
▨ Plains Bristlegrass
☐ Other Per. Grasses

Chart 12

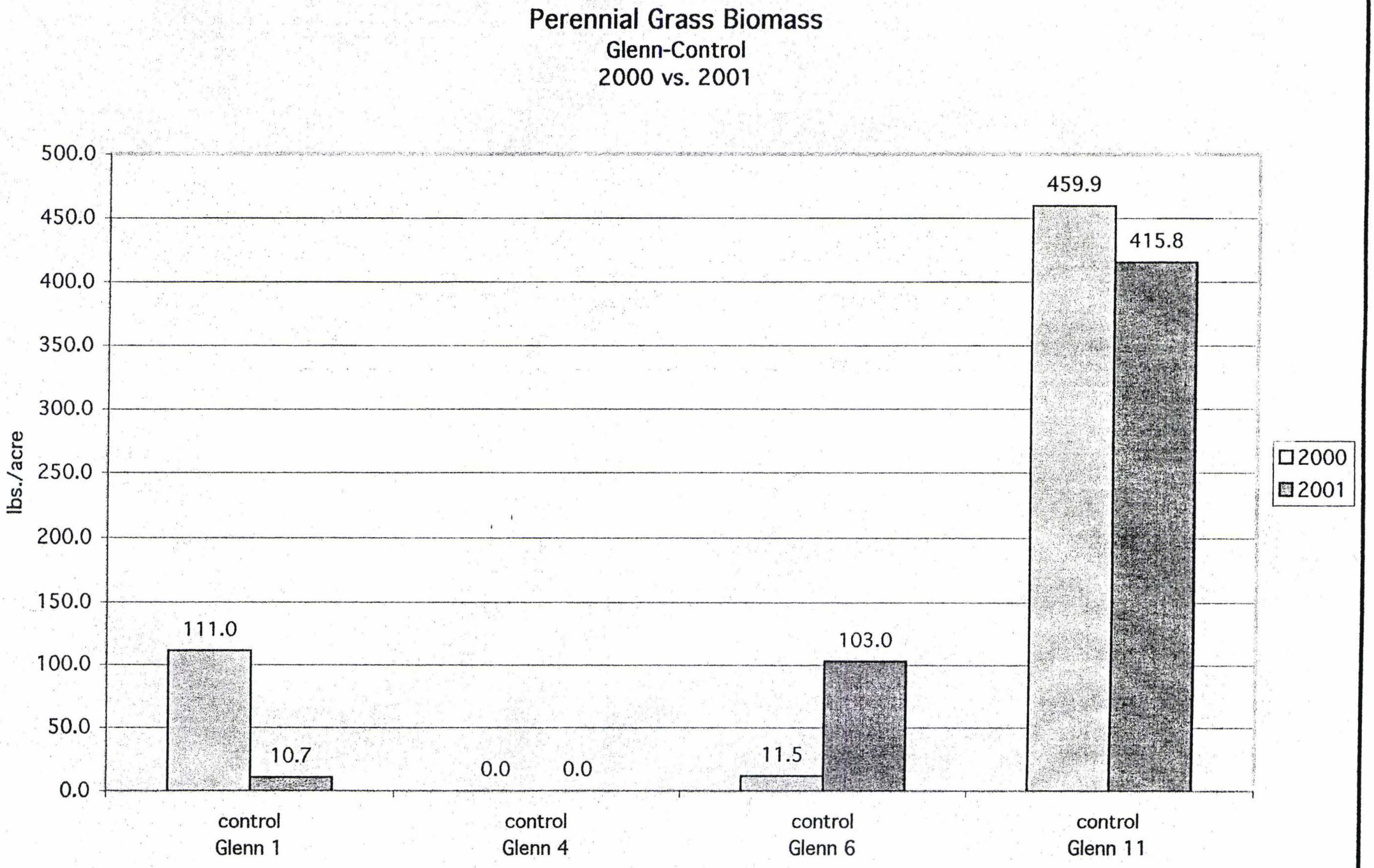

Perennial Grass Biomass
Glenn-Control
2000 vs. 2001
lbs./acre
500.0
450.0
400.0
350.0
300.0
250.0
200.0
150.0
100.0
50.0
0.0
111.0
10.7
0.0
0.0
11.5
103.0
459.9
415.8
control Glenn 1
control Glenn 4
control Glenn 6
control Glenn 11
□ 2000
▨ 2001

Chart 13

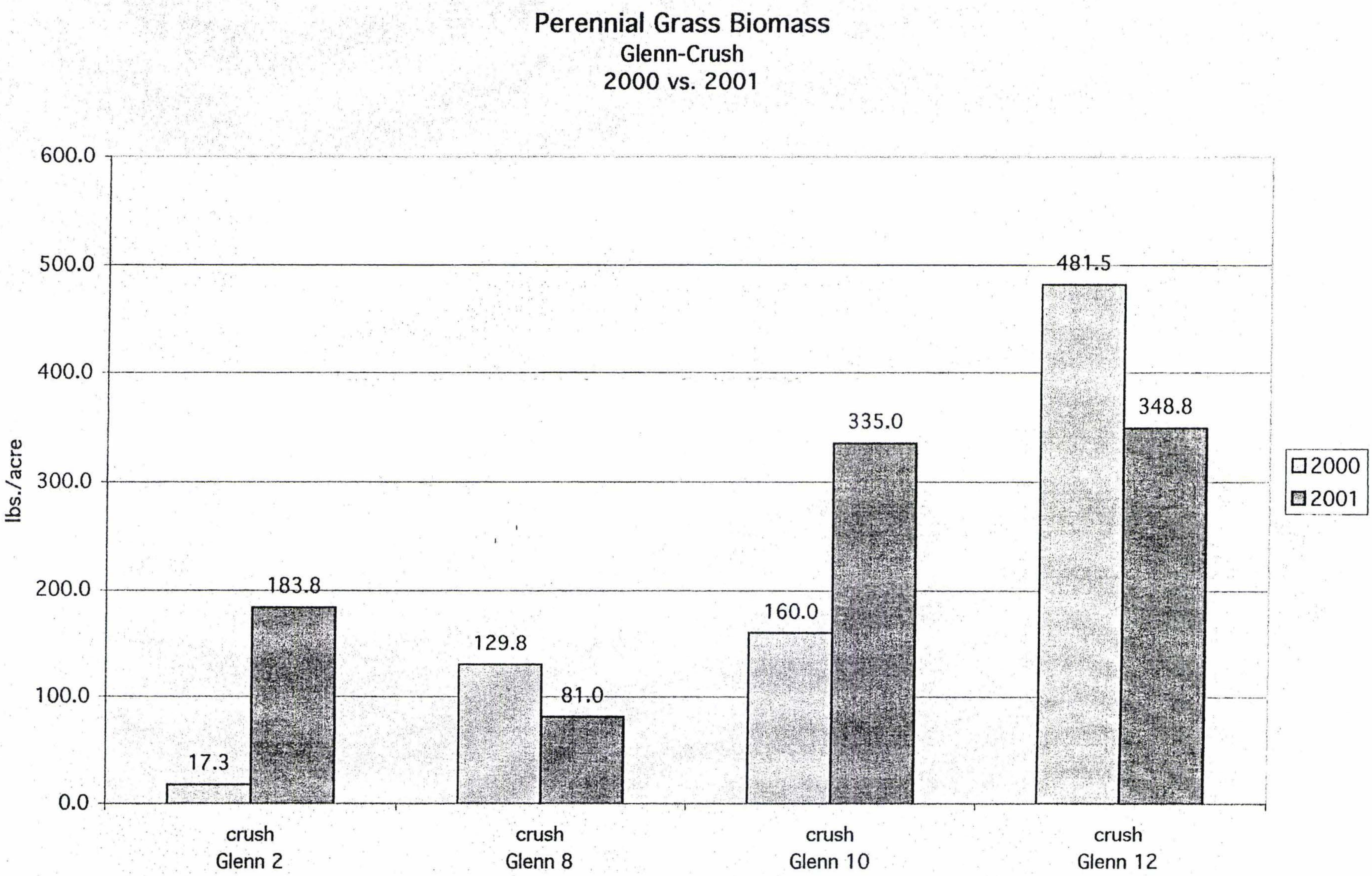
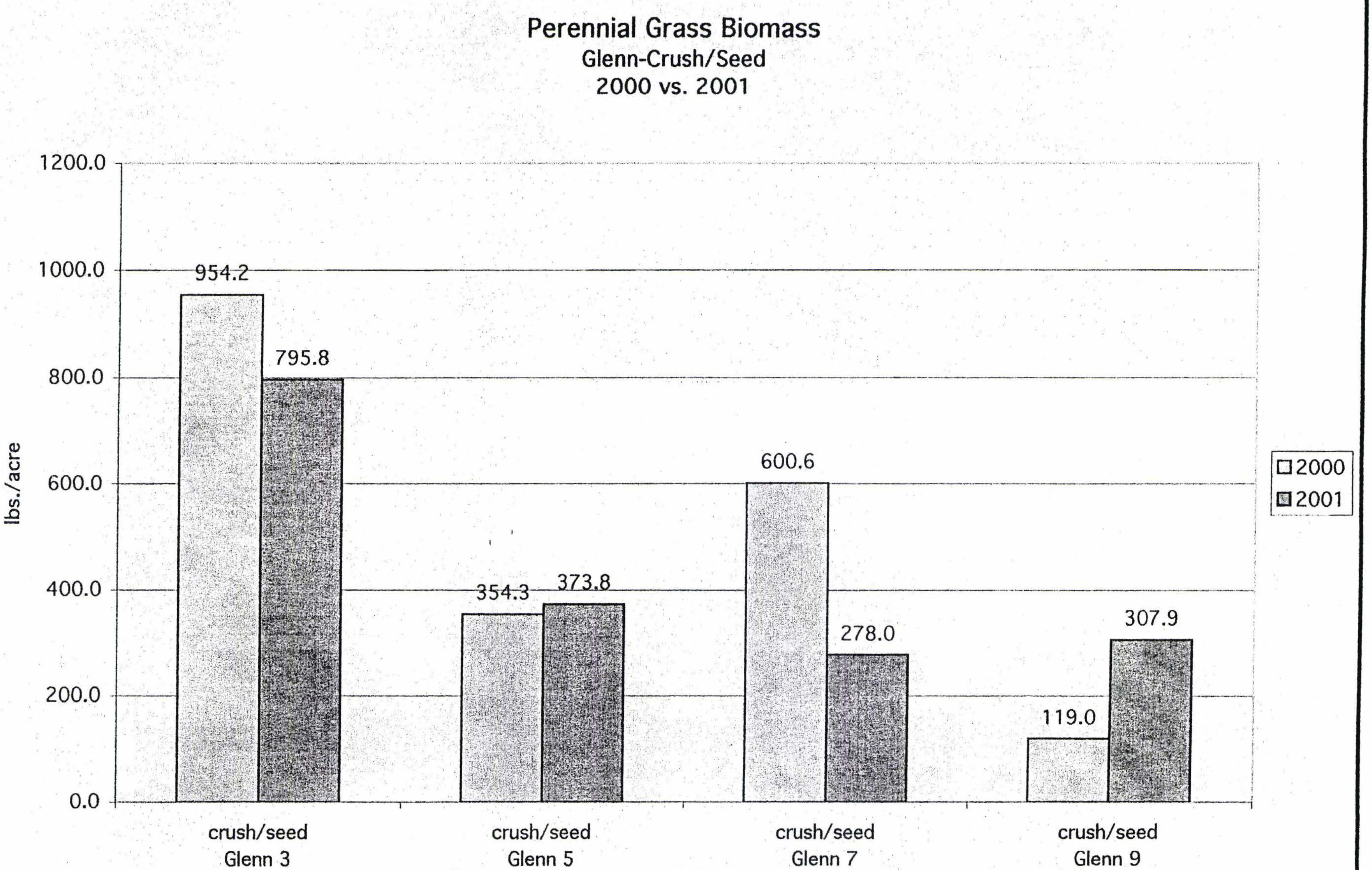

Perennial Grass Biomass
Glenn-Crush
2000 vs. 2001
lbs./acre
600.0
500.0
400.0
300.0
200.0
100.0
0.0
17.3
183.8
129.8
81.0
160.0
335.0
481.5
348.8
crush Glenn 2
crush Glenn 8
crush Glenn 10
crush Glenn 12
□ 2000
▨ 2001

Chart 14



Perennial Grass Biomass
Glenn-Crush/Seed
2000 vs. 2001

Chart 15

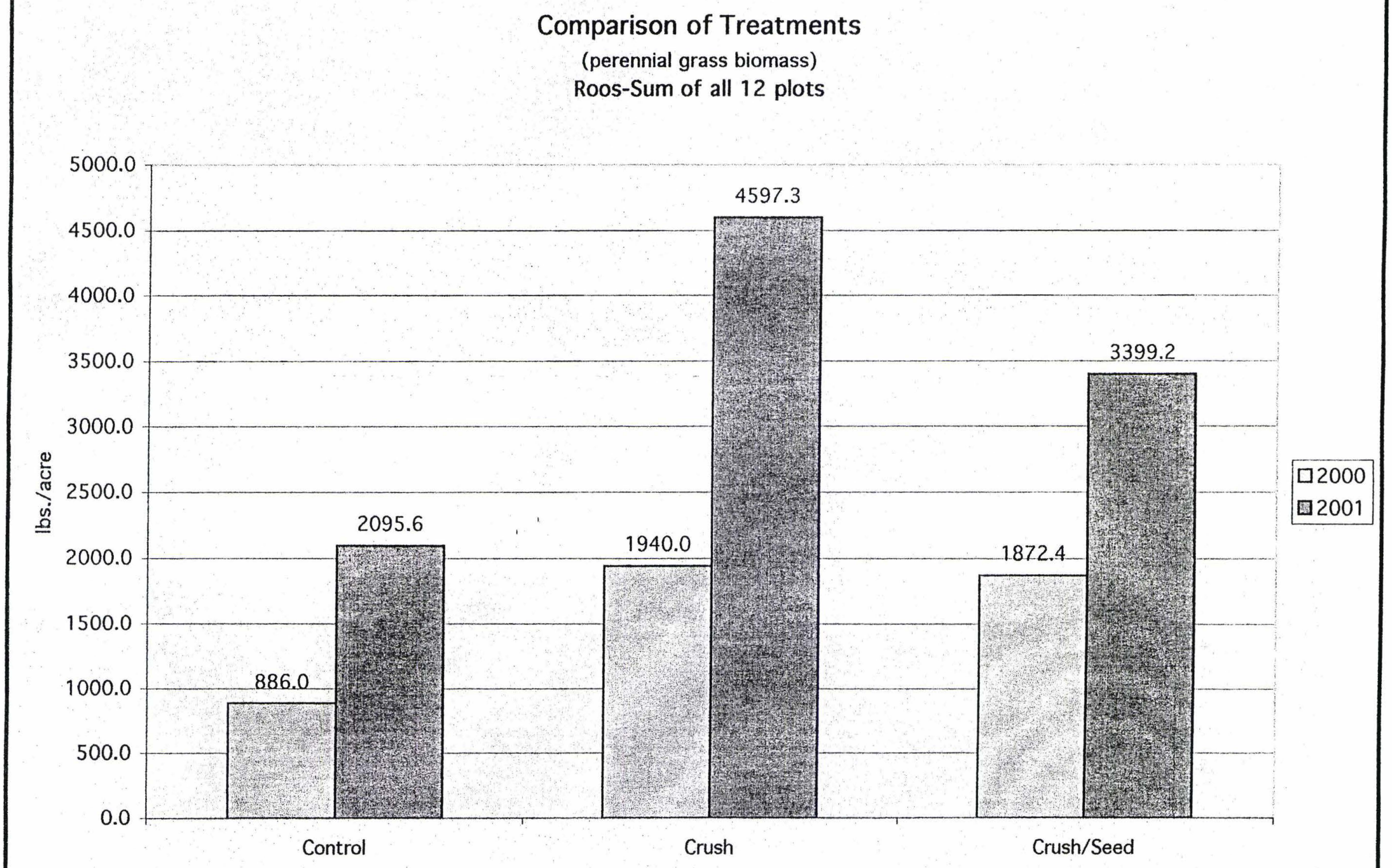

Comparison of Treatments
(perennial grass biomass)
Roos-Sum of all 12 plots
lbs./acre
5000.0
4500.0
4000.0
3500.0
3000.0
2500.0
2000.0
1500.0
1000.0
500.0
0.0
886.0
2095.6
1940.0
4597.3
1872.4
3399.2
Control
Crush
Crush/Seed
□2000
▨2001

Chart 16

Percent Contribution to Perennial Grass Production by Species
Roos-2001

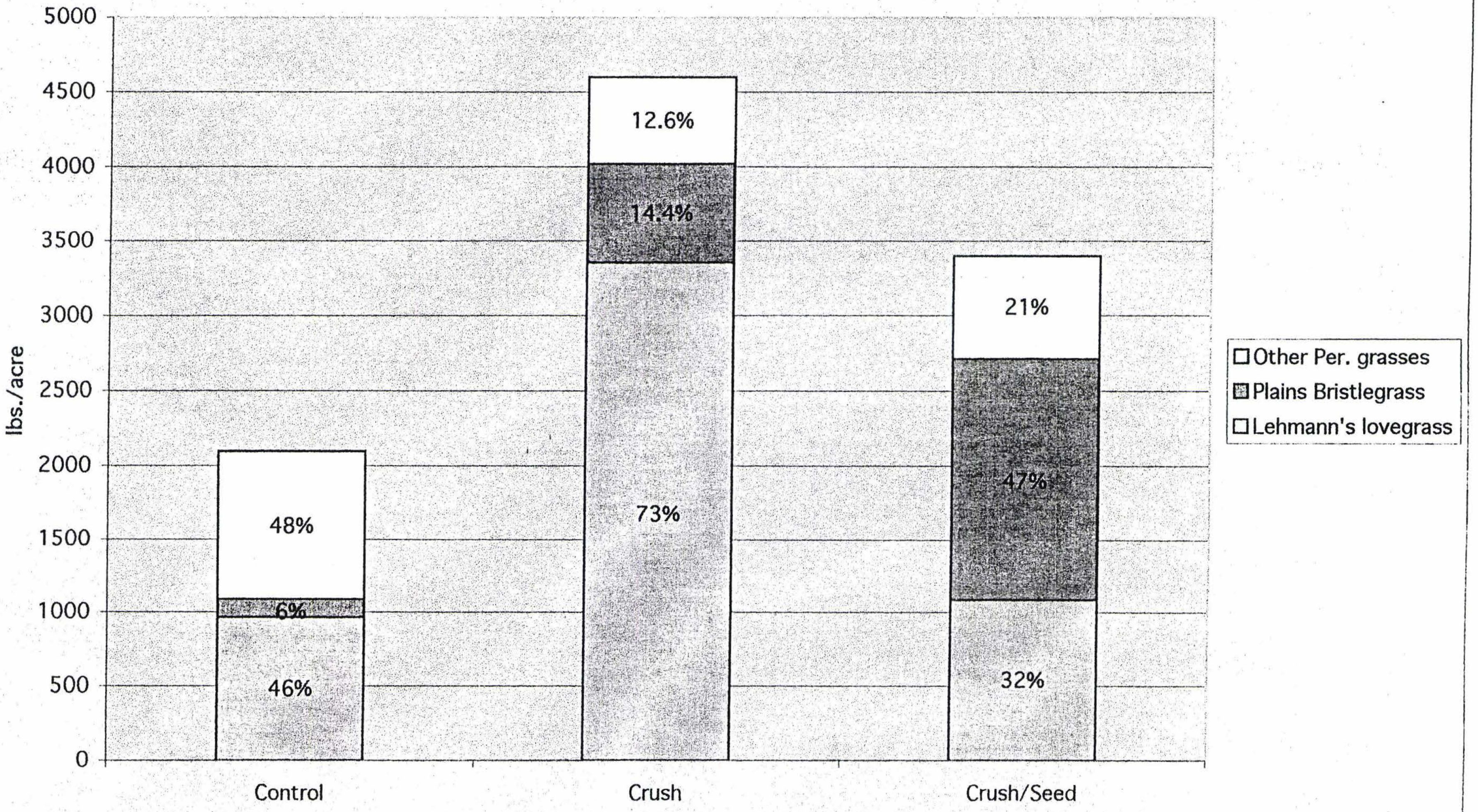
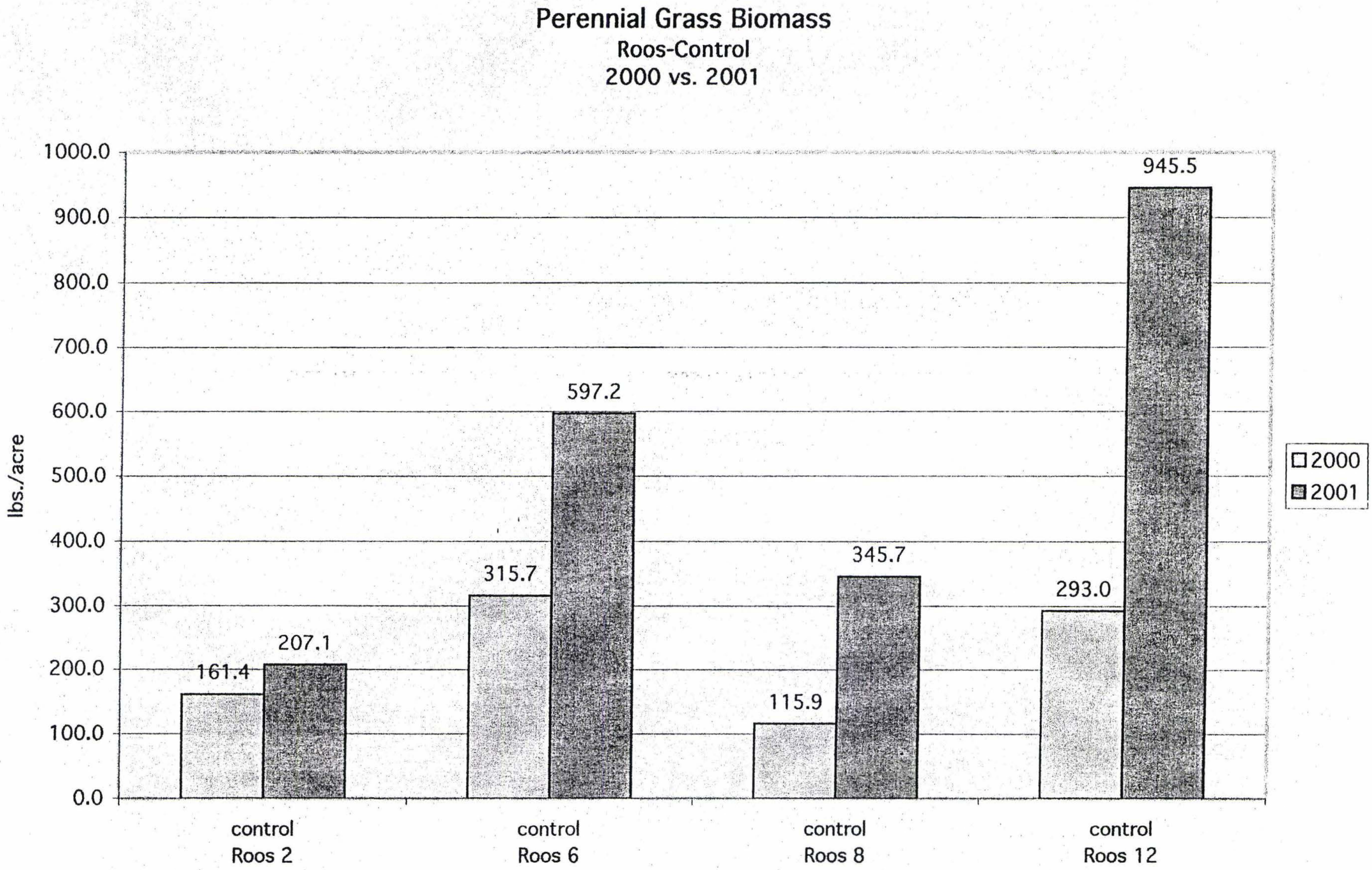


Chart 17



Perennial Grass Biomass
Roos-Control
2000 vs. 2001

Chart 18

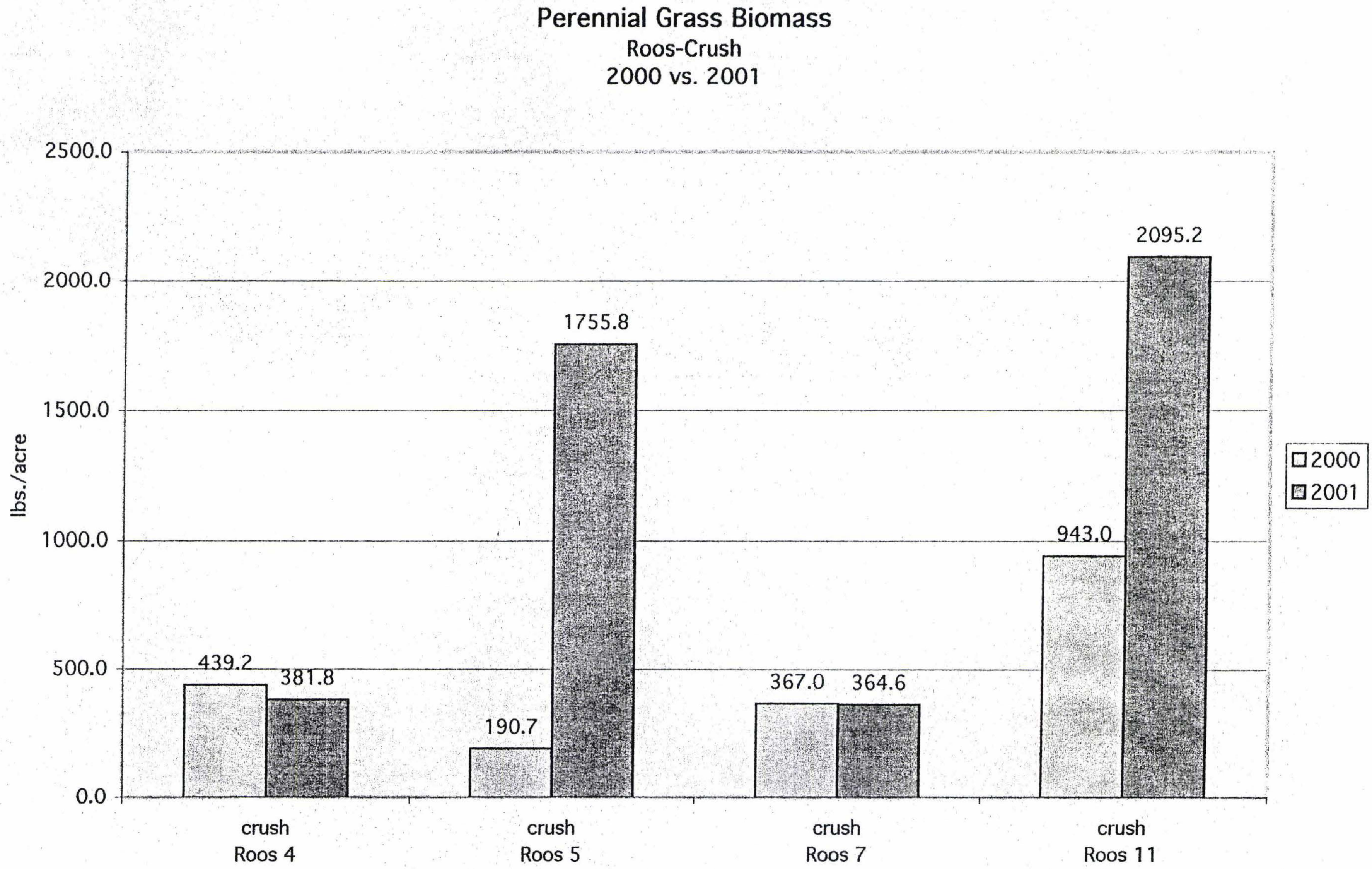
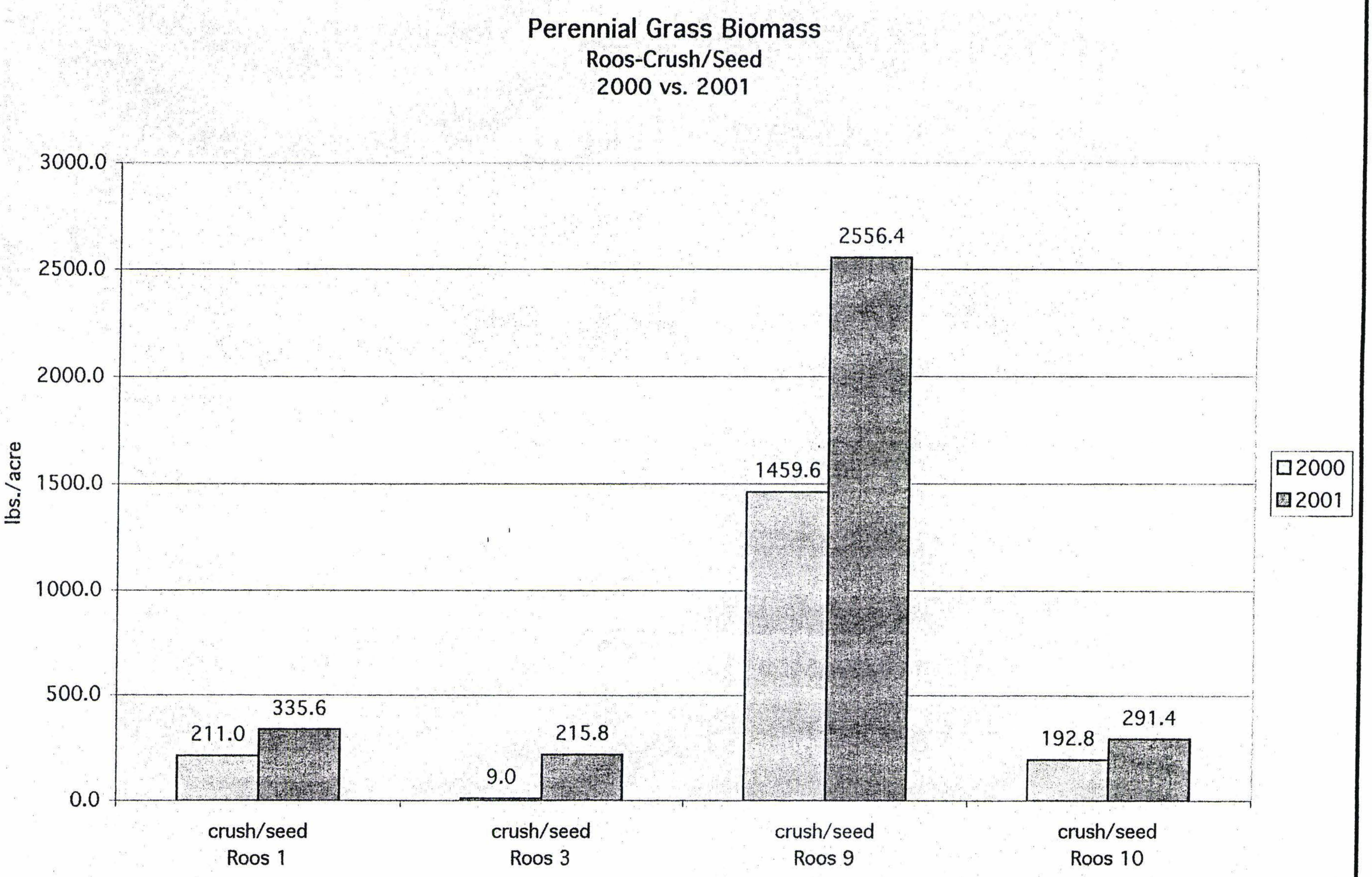

Perennial Grass Biomass
Roos-Crush
2000 vs. 2001
lbs./acre
2500.0
2000.0
1500.0
1000.0
500.0
0.0
439.2
381.8
190.7
1755.8
367.0
364.6
943.0
2095.2
crush Roos 4
crush Roos 5
crush Roos 7
crush Roos 11
□ 2000
▨ 2001

Chart 19



Perennial Grass Biomass
Roos-Crush/Seed
2000 vs. 2001

Chart 20

Production Estimates for Roos, Glenn, Gray Treatment Plots
Year 2000

3/19/01

Myles Traphagen
2833 Belhaven Pl.
Davis, CA 95616
(520) 991-6368

This report provides year 2000 production estimates for 3 sites that received brush crushing treatments in 1999. The three sites are: Glenn Ranch, Roos Ranch and Gray Ranch (George Wright pasture). Biomass estimates were taken during the Fall of 2000 between the dates of 11/22/00 to 12/9/00 using SCS protocol for determining production and composition. This double sampling method is described in detail in the National Range Handbook. Each treatment site contains twelve plots that measure 500 by 500 feet. One transect, consisting of ten 9.84 sq. ft. quadrats was placed in the center of each plot. Ten quadrats were sampled for herbaceous and non-woody shrub cover. Woody shrubs, such as creosote, mesquite and tarbush were not measured. Snakeweed and burrobrush were measured. A minimum of 2 out of the ten quadrats were clipped and weighed. Plant material averaged about 80% dry weight after 2 weeks of air drying sub-samples from each site. Precipitation data is not yet available for all sites. Subsequent reports will include precipitation data for each site and as well as data from previous year's measurements of production.

Production calculations were made using an Excel 97 spreadsheet program. This proved to be faster and more accurate as well as making the data easier to access for writing future reports. The raw data sheets, in addition to a computer disc, have been sent to Gerry Gottfried of the US Forest Service. Ron Bemis, of the NRCS Douglas Field Office, also has a disc containing the raw data and production calculations.

Production Summary Table for Treatment Plots Year 2000

Plot	Treatment	TAP (lbs/acre)	% Plant Cover	% Bare Ground	% Rock
GW 1	crush/seed	1505	54.4	42	3.6
GW 2	crush	1828	27	65.3	6.8
GW 3	crush	720	24	69.8	6.2
GW 4	control	369	21.1	73.8	5.1
GW 5	crush/seed	438	25	65.2	9.8
GW 6	control	692	29.5	64.8	6.2
GW 7	control	352	30.9	63.8	5.3
GW 8	crush	1653	53.7	45.3	2
GW 9	control	705	31	61	8
GW 10	crush/seed	1004	40.5	52.5	7
GW 11	crush	773	32.4	60.8	6.8
GW 12	crush/seed	464	20.3	70	10.2
Roos 1	crush/seed	251	16.1	81.7	2.2
Roos 2	control	365	20.6	76.4	3
Roos 3	crush/seed	367	26	68.2	5.8
Roos 4	crush	1544	54.7	36.5	8.8
Roos 5	crush	367	35.8	52.3	11.9
Roos 6	control	576	30.6	66.1	3.3
Roos 7	crush	562	21.2	69.2	9.6
Roos 8	control	478	39.5	49.2	11.3
Roos 9	crush/seed	1782	36.3	33	29.2
Roos 10	crush/seed	694	39.8	46.5	13.7
Roos 11	crush	1298	40.5	40	19.5
Roos 12	control	864	57.7	33.5	8.8
Glenn 1	control	170	16	58.5	25.5
Glenn 2	crush	58	5.4	88.3	6.3
Glenn 3	crush/seed	972	26.7	54.1	19.2
Glenn 4	control	0	13.8	53	33.2
Glenn 5	crush/seed	389	16.9	67	16.1
Glenn 6	control	23	19.1	69.6	11.3
Glenn 7	crush/seed	612	12	75.5	12.5
Glenn 8	crush	190	10.6	56.8	32.6
Glenn 9	crush/seed	265	10.2	81.9	7.9
Glenn 10	crush	518	38.1	58.7	3.2
Glenn 11	control	611	35.6	55.8	9.7
Glenn 12	crush	615	39.1	57.4	3.4

Species List for Production Plots

Plant name	Scientific name	Common name
6 WKS GRAMA	Bouteloua barbata	Six weeks grama
6 WKS NEEDLE	Bouteloua aristoides	Needle grama
ACOU	Acourtia sp.	Desert holly
AMARANTH	Amaranthus palmeris	Pigweed, careless weed
ANN FORB	unknown annual forb	
ANN GRASS	unknown annual grass	
ARISTIDA	Aristida spp.	Three awn
AZ PANIC	Panicum arizonicum	Arizona panicgrass
BOBA	Bothrichloa barbinodis	Cane beardgrass
BOCU	Bouteloua curtipendula	Sideoats grama
BOER	Bouteloua eriopoda	Black grama
BOGR	Bouteloua gracilis	Blue grama
BORO	Bouteloua rothrockii	Rothrock grama
CHVI	Chloris virgata	Feather fingergrass
COMP SHRUB	Asteraceae family shrub	
CRCO	Croton columbiformis	leather weed
DAPU	Erioneuron pulchellum	fluffgrass
DICA	Digitaria californicus	Arizona cottontop
EPHEDRA	Ephedra trifurca	mormon tea
ERIN	Eragrostis intermedia	plains lovegrass
ERLE	Eragrostis lehmanni	Lehmann's lovegrass
ERWR	Eriogonum wrightii	Wright buckwheat
EVOL	Evolvulos alsinoides/nuttallianus	-
FILAREE	Erodium cicutarium	Redstem filaree
GUSA	Guitterizia sarathroides	snakeweed
HIMU	Hilaria mutica	tobosa
HODE	Hoffmanseggia densiflora	hog potato
ICTE	Isocoma tenuisecta	Burroweed, Jimmyweed
ISTE	Isocoma tenuisecta	Burroweed, Jimmyweed
LEDU	Leptochloa dubia	green sprangletop
MUAR	Muhlenbergia arinicola	Sand muhly
MUPO	Muhlenbergia porterii	bush muhly
PANSP	Panicum sp.	panic grass
PAOB	Panicum obtusum	vine mesquite
Reefer	Rumex	Refrigerator plant
RUMEX	Rumex	Refrigerator plant
SAKA	Salsola kali	russian thistle/tumbleweed

SCBR	Scleropogon breviflora	Burrograss
SEMA	Setaria macrostachya	plains bristlegrass
SIDA	Sida abutifolia/physocalyx	
SOEL	Solanum eleaginfolium	common groundcherry
SPCO	Sporobolus contractus	mesa dropseed
SPCR	Sporobolus cryptandrus	sand dropseed
SPSP	Sphearalcea angustifolia	globe mallow
ZIGR	Zinnia grandiflora	Desert zinnia

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Dear Gerry, 1/30/01

Here is the vegetation report for year 2000 at the Cascabel. Please give me feedback on what you feel are important aspects of the data to analyze and to present in subsequent reports. For this report I felt that the data should be descriptive in nature and focus on describing and characterizing the vegetation. Therefore, the summary table for all plots contains 7 categories that I feel are the most important features of the vegetation /soil component of the landscape. The watersheds are all rather similar in terms of vegetation/soil composition, with the exception of watershed H, and to lesser degree B. H contains so much shrub and tree cover, especially manzanita, that the possibility of an extremely hot fire is high. However, the high amount of bare rock and and low grass cover may mitigate this somewhat. I'm sure that you have taken this into consideration, but I just wanted to draw this particular watershed to your attention.

I may have talked to you about low level aerial photography (< 1000 feet), but you might want to think about this because I think that it may be helpful in getting a good overview of the entire watershed in the event that the plots within the watershed don't burn. I've enclosed a small report describing the method. I'll be working in Argentina until February 28th, so I'll have to wait for the production data until after I get back. I wanted to focus on the watershed data first. The plots were clipped in December, so the data has been collected, I just need to do the calculations on the 36 plots.

Sincerely,

Myles Traphagen

Vegetation Sampling Report for USFS Cascabel Ranch Watershed Research Study
Year 2000

submitted by
Myles B. Traphagen
Turn of the Century Restoration & Monitoring Inc.
2833 Belhaven Pl.
Davis, CA 95616
(520) 991-6368

January 30, 2001

Vegetation Sampling Report for USFS Cascabel Ranch Watershed Research Study Year 2000

Introduction

In November of 2000 vegetation sampling was performed on the Cascabel Ranch allotment of the Coronado National Forest-Peloncillo District. The research site lies immediately north of Whitmire Canyon on the eastern edge of the Peloncillo Mountains in New Mexico approximately 20 miles south of Animas, New Mexico. It is bordered on the east by the Animas Valley. Elevation is approximately 5400 ft. The site lies in the Madrean biogeographic province and the vegetation can be classified as Madrean Evergreen Woodland (Brown & Lowe 1978). Dominant overstory species include Emory oak (*Quercus emoryii*), Gray oak (*Quercus grisea*), Alligator juniper (*Juniperus deppiana*) and Mexican pinyon (*Pinus cembroides*). Shrubs include Skunkbush sumac (*Rhus trilobata*), Wright's silktassel (*Garrya wrightii*), Schott yucca (*Yucca schotti*), Palmer agave (*Agave palmeri*) manzanita (*Arctostapylos hookeri*) and beargrass (*Nolina microphylla*). Several small cacti are also found throughout the site. Perennial grasses are abundant. Of particular note is the dominant presence of purple grama (*Bouteloua radicosa*), which was found in every plot. Other grasses common to virtually every plot are little bluestem (*Schizachrium cirratum*), bull muhly (*Muhlenbergia emersleyi*), blue grama (*Bouteloua gracilis*), sideoats grama (*Bouteloua curtipendula*) and wolftail (*Lycurus pheloides*).

A central ridge divides the drainages of Whitmire and Walnut Creeks. An access lies atop this ridge that allows for access to twelve plots. Six plots lie north of the ridge and drain into Walnut Creek, and the remaining six more are south of the ridge and drain into Whitmire Creek. The terrain consists of moderate to steep canyons of about 100 to 400 foot in depth with the plots lying within these canyons. A great deal of rock is exposed and soil depths are shallow within the canyons.

Description of plots

A total of 24 plots were established at the site, 2 for each watershed. All watersheds have either west-east or north-south aspects, therefore a plot was placed on either side of the watershed so that both aspects could be captured. Slope aspect caused no significant difference in vegetation composition on either side of the watershed. The size of the plots are 50m by 100m. There are 6 transects of 50m length that start about 2m up from the bottom of the drainage and extend towards the top of the watershed (see Figure A). Therefore, each watershed contains twelve 50m transects. Each transect contains 25, 40cm x 40cm quadrats to measure frequency. 100 point line intercept data points are taken to measure cover. Therefore, each watershed contains 300 quadrats to measure frequency and 1200 points to measure cover.

Methodology

The plot measures 50 x 100m and contains 6 parallel transects of 50m in length. Transects are spaced 20m apart along the 100m baseline which runs parallel to the creek bottom(see fig. 1). The first transect sampled is on the 0m baseline and the last transect sampled is 100m. 40cm square quadrats are placed at 2m intervals along each of the transects starting at 2m and ending at 50m for a total of 25 quadrats per transect and 150 for the entire plot. Within each frame all species are recorded on data sheets. Each species encountered is recorded only once despite its abundance or lack thereof in the quadrat. Example: Within the frame (40cm square) 10 purple grama plants are present and 1 sideoats plant is present. Despite the vastly different ratio of purple to sideoats grama, they each receive only 1 entry on the data sheet. It is simply a presence/absence of measurement that is ultimately averaged out over the entire plot. Cover measurements are then taken from the same quadrat immediately after measuring frequency. A point (a thin poker stick such as a marking flag or dowel rod) is dropped in each of the four corners of the frame. Whatever object the point strikes is the object recorded, with multiple hits being allowed. This measures canopy cover, therefore any part of a plant hit is recorded on the data sheet. Soil and litter are exclusive hits; i.e. you can't get a hit on purple grama and soil or litter at the same time. Soil is recorded only if no plant material is struck by the point. Litter is compacted, organic matter and grounded dead plant material. 4 "hits" are taken per quadrat for a total of 100 data points per transect and 600 data points for the entire plot. Since each watershed contains 2 plots, the total number of cover data points is 1200.

The sampling unit is the transect, which contains 100 points. This is appropriate when a high degree of variability exists between each data point and when monitoring multiple variables such as species, bare ground and litter composition. Therefore, confidence intervals are calculated using the averages of all the transects in the plot as opposed to within an individual transect.

Cover

Cover is useful in obtaining measurements of soil, rock and litter, a measurement frequency is not capable of. Cover is a common measure of community composition and most directly relates to biomass (Elzinga, et al 1998). Unlike frequency, which is a measurement of species occurrence within a given plot, cover measurements produce values which reflect the actual percentage of a given species (or bare ground/litter) in the plot. Therefore, cross site comparisons can be made regardless of plot size. A disadvantage of cover is that it is subject to high variability throughout the course of a season. This is due to the fact that rainfall and herbivory can have a dramatic effect upon plant size. If a population of grasses is grazed before the plot is sampled, then low cover values may be reported. However, the same number of plants may still exist within the plot, and within a few weeks the population could regain its original biomass, therefore increasing cover values. Basal cover, which measures only the central, rooted mass of a plant is less subject to variation throughout the season, but results obtained are less accurate. A pilot study conducted in spring of 2000 on the Armendaris Ranch found that it was impossible to detect a 20% change in basal cover of black grama at an 80% confidence interval using the point-intercept method, yet it is common for researchers to report small changes in basal cover (Traphagen and Sundt in prep.). Walker (1970), working in grasslands of Rhodesia, reported the same problem when measuring plants with small basal area. He concluded that 2000 points would be required to detect a 10% change in cover at the 95% confidence interval of a plant with only 8% cover. Aerial cover, which combines canopy and basal measurements, is therefore a more accurate method for reporting cover values of species with small basal areas (Traphagen and Sundt, in prep.).

Frequency

Frequency offers several advantages over cover and density measurements. One of the principle uses of frequency is for tracking changes in species composition over time. When active management and restoration is underway this could be especially important information for land managers. Frequency is also useful in plots containing a relatively high degree of species diversity and is therefore a good tool for obtaining an index of diversity because of the ability of frequency to detect small species with low relative cover. Another advantage of using frequency is that it is subject to a smaller degree of variation over the season than cover, because changes in the density of rooted species within a season are usually small (Elzinga, et al 1998). Cover values can change dramatically over a short period of time because they are much more subject to perturbations of climate and herbivory. Therefore, the season for sampling can be extended for a greater amount of time when using frequency. A disadvantage of frequency is that the values obtained are based upon quadrat and plot size and the distribution of the species being measured. Therefore, cross site comparisons cannot be made unless the plots were identical in size and sampling intensity and plant ecology.

Results

Appendix A contains a table that summarizes the results of all 24 plots. Six categories were used to separate data into the most relevant variables; Bare ground, rock, litter, perennial grass basal cover, perennial grass aerial (leaf) cover and perennial grass combined basal and aerial cover. Aerial cover of vegetation is measured because of the soil protection it offers from rain impact and wind erosion. Basal cover could be an important factor affecting overland sheet flow of precipitation runoff, a potentially important variable to measure for in this study. Percentages shown represent the mean for each plot using 6, 50m transects. Below the main table there is a summary of all plots showing the basic statistics of mean, standard deviation (SD), standard error (SE) and the 95% confidence interval. The purpose of this summary table for all plots is so that a comparison can be made to asses similarity and dissimilarity between plots.

The summary table for all plots is graphed using an X Y scatter plot. Total perennial grass cover and bare ground were graphed, as they are the two most important variables used to asses the variance between plots. The plots are all aligned on the Y axis, which is the mean for all plots combined. Along the X axis the plots are aligned according to their individual means, therefore plots the plots that are most similar to each other are centered around the mean and clustered together. Outliers are labeled and can be easily discerned. Watersheds B and H are the most unlike the majority in terms of bare ground and perennial grass cover. B lies on the south side of the central ridge and drains into Whitmire Creek, and H is on the north side of the central ridge and drains into Walnut Creek. Tree and shrub cover is more variable between plots, but this may be more attributable to sampling design and error than actual values present at each plot.

Literature Cited

Brown, David E. Charles H. Lowe. 1980. Biotic Communities of the Southwest. USDA Forest Service Technical Report RM-78. Rocky Mountain Forest and Range Experiment Station. Fort Collins, Colorado.

Elzinga, C.L., D.W. Salzer and J.W. Willoughby. 1998. Measuring and Monitoring Plant Populations. BLM Technical Reference 1730-1.

Walker B.H. 1970. An evaluation of eight methods of botanical analysis on grasslands in Rhodesia. Journal of Applied Ecology. 7: 403-416.

Wilhite D.A. & K.G. Hubbard 1998 in: An Atlas of the Sand Hills. Ann S. Bleed and Charles Flowerday editors. 3rd edition. Resource atlas no. 5b. Conservation and Survey Division, Institute of Agriculture and Natural Resources, University of Nebraska-Lincoln

GPS Coordinates

GPS coordinates were taken at each plot using UTM. Estimated position error was calculated at 3m using a Garmin GPS II+.

Watershed	GPS	Coordinate
M	**12 R 0691746**	**UTM 3491570**
EB	**12 R 0691422**	**UTM 3491456**
K	**12 R 0691272**	**UTM 3491632**
F	**12 R 0692127**	**UTM 3491090**
G	**12 R 0692257**	**UTM 3490826**
C	**12 R 0690654**	**UTM 3491649**
N	**12 R 0691941**	**UTM 3491466**
D	**12 R 0691016**	**UTM 3491586**
I	**12 R 0690435**	**UTM 3491844**
J2	**12 R 0691380**	**UTM 3491928**
B	**12 R 0690307**	**UTM 3491609**
H	**12 R 0690049**	**UTM 3491894**

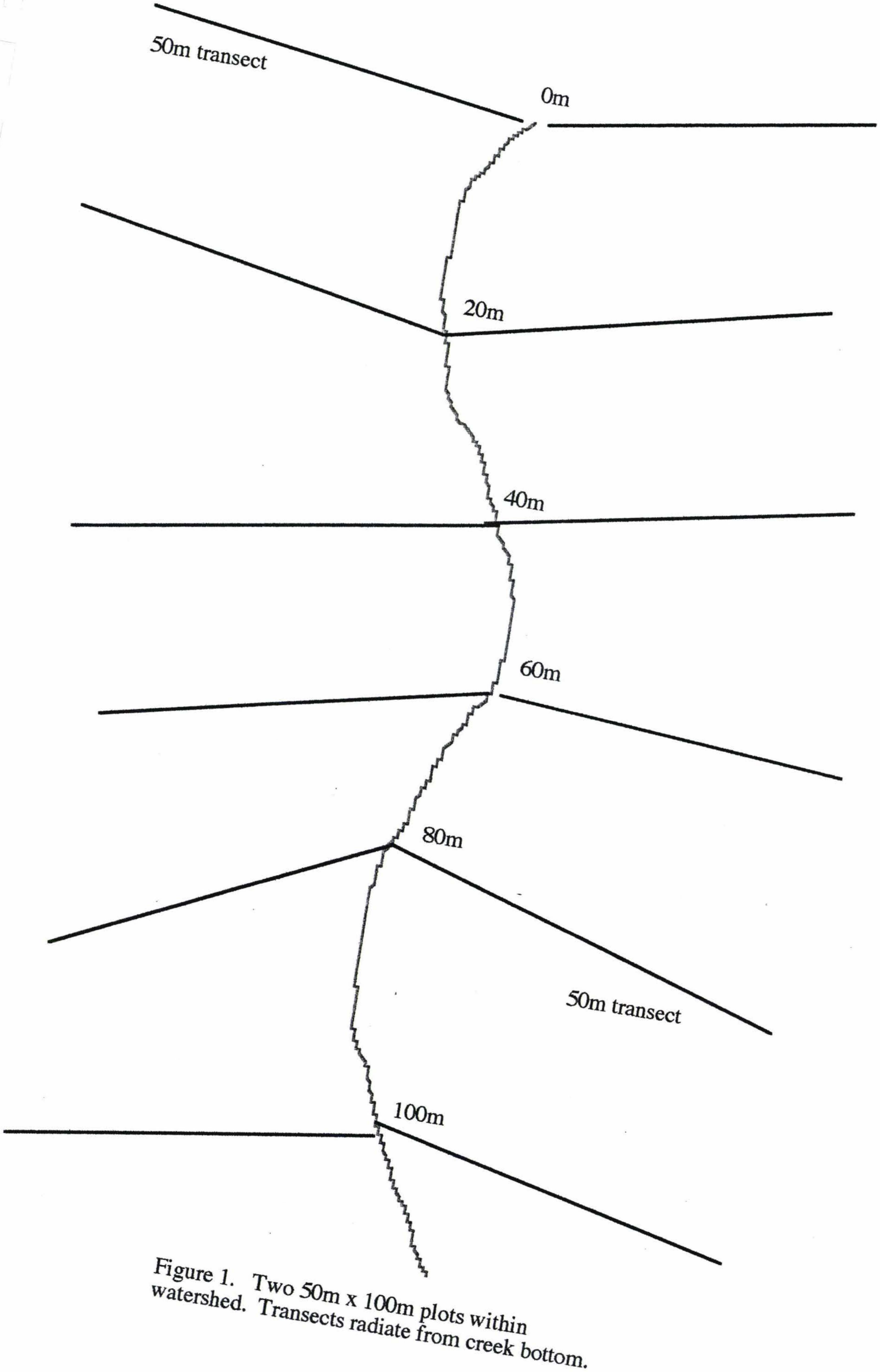
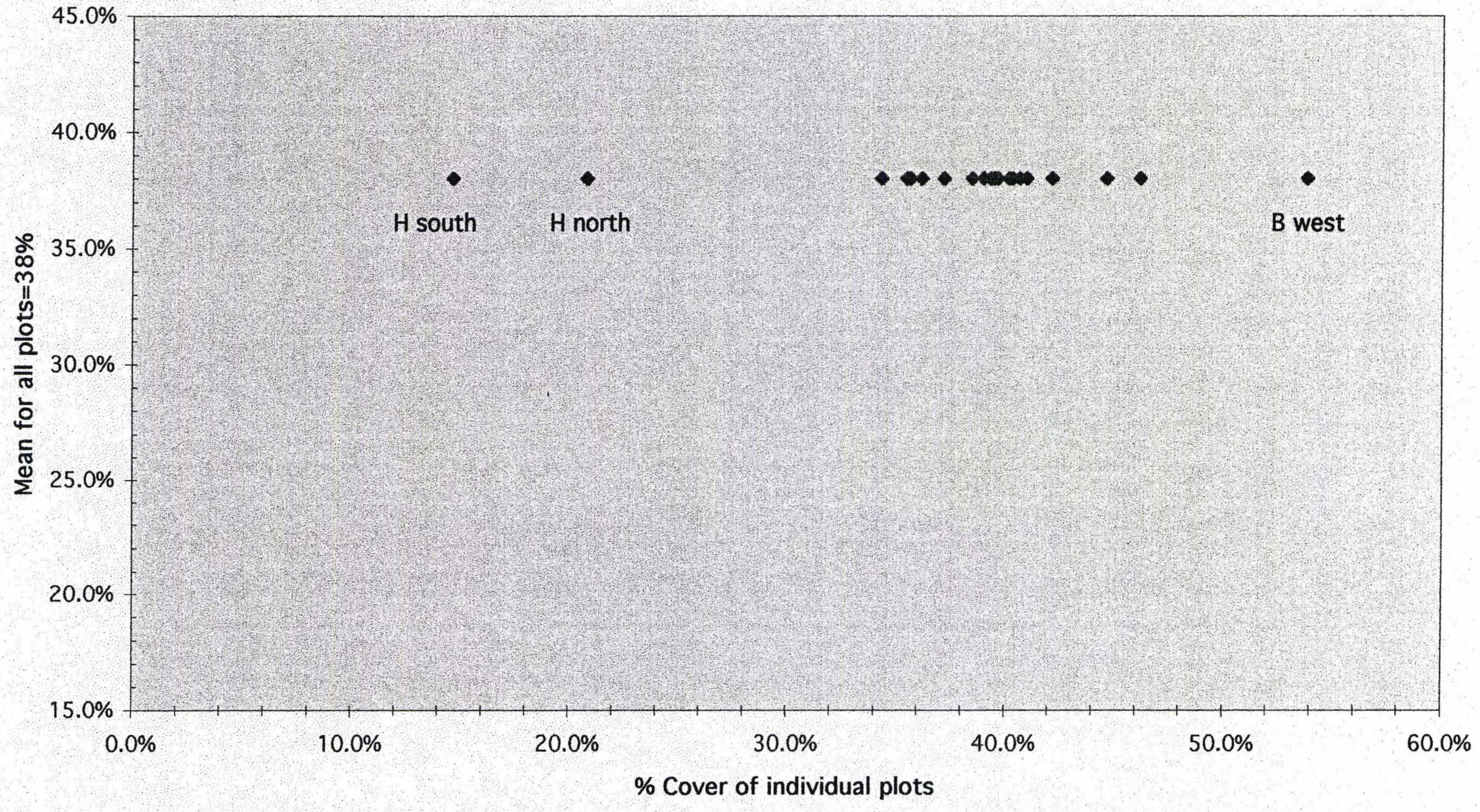

50m transect
0m
20m
40m
60m
80m
50m transect
100m

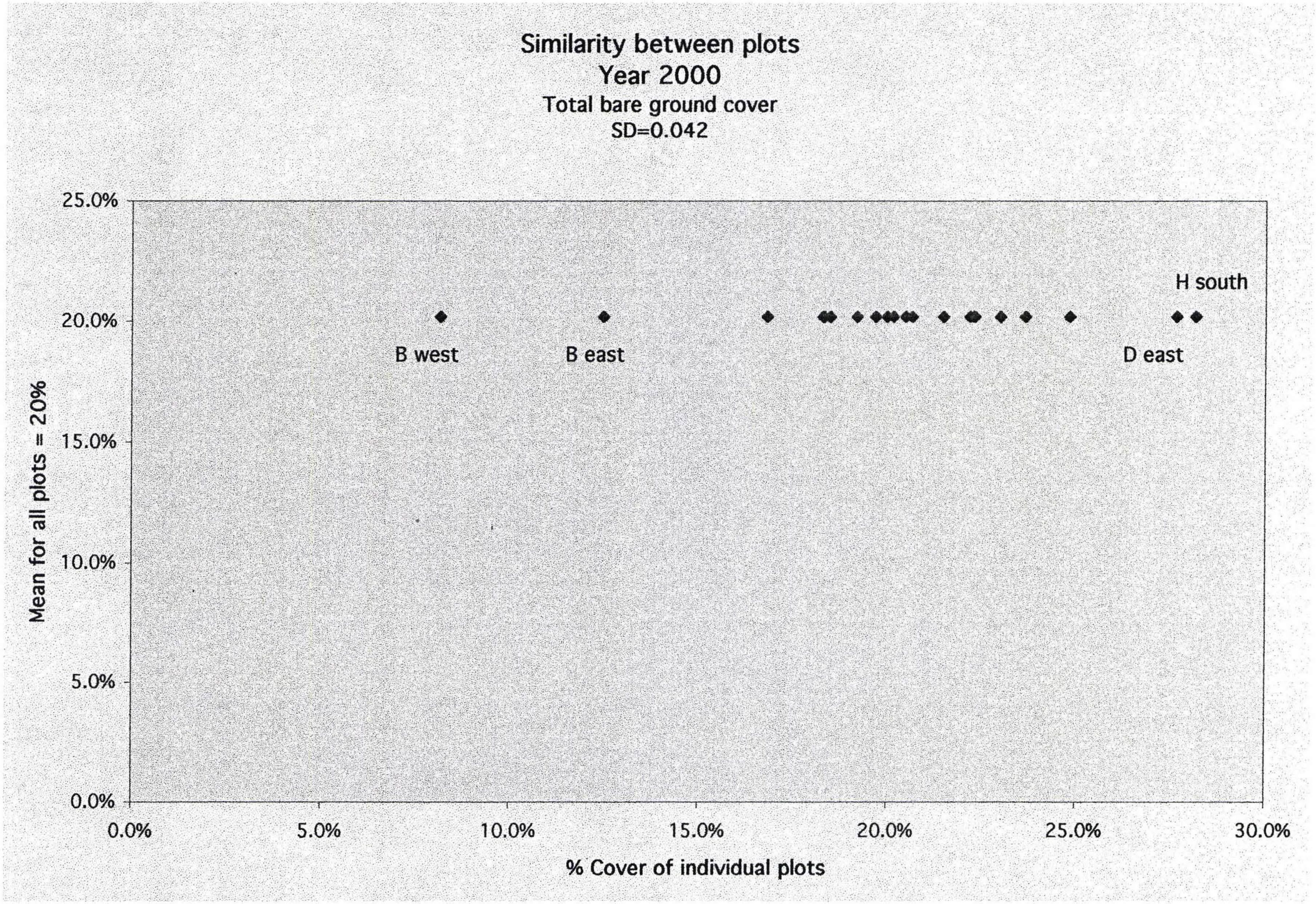
Figure 1. Two 50m x 100m plots within watershed. Transects radiate from creek bottom.

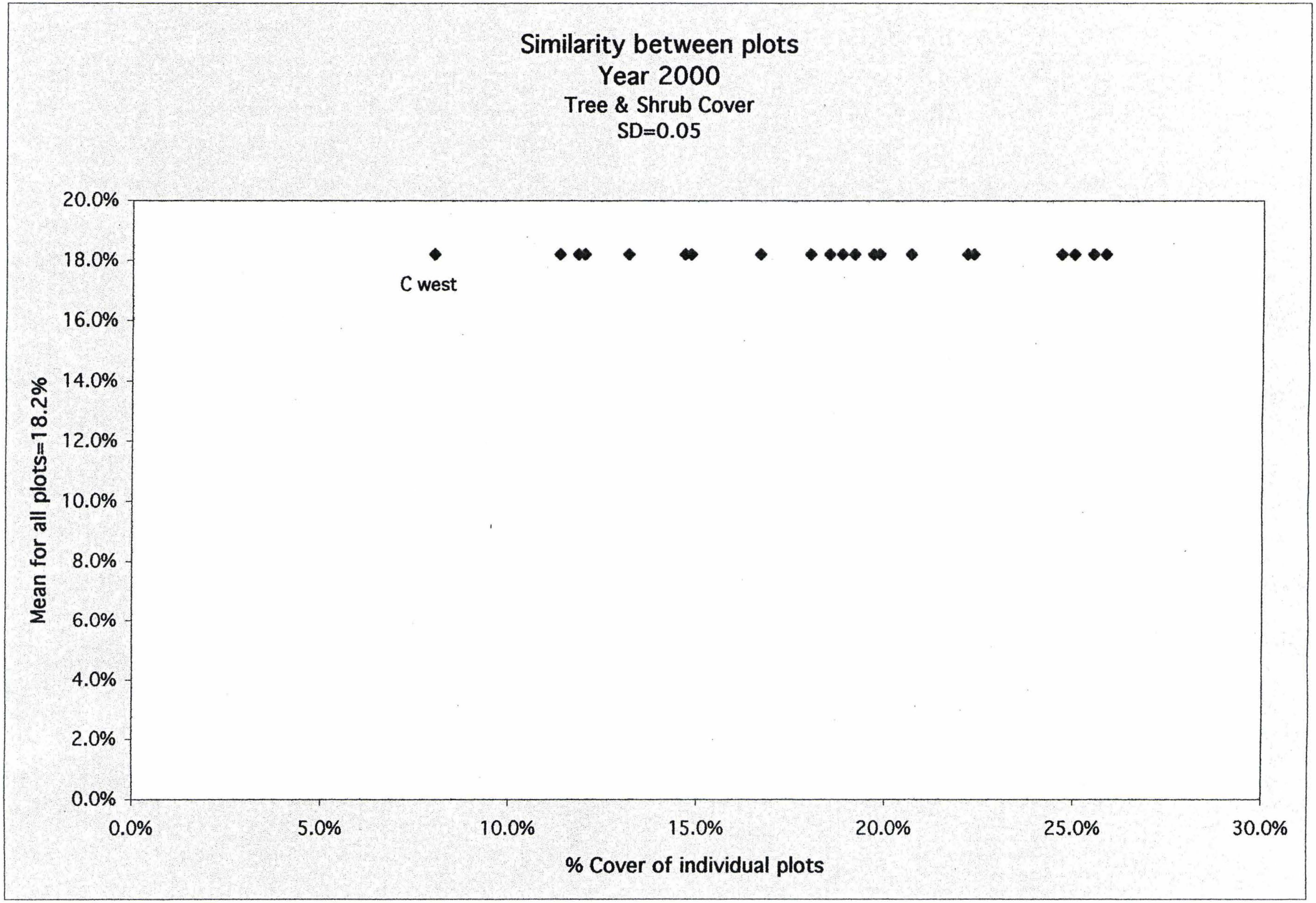
Cascabel Totals
Fall 2000

Watershed	Bare ground	Rock	Litter	Per. Gr. Basal	Per. Gr. Leaf	Per. Gr. Total	Tree & shrub c
M north	20.0%	9.3%	12.2%	10.0%	34.7%	44.7%	25.0%
M south	18.3%	9.0%	16.2%	10.3%	35.8%	46.2%	16.7%
EB north	19.7%	17.5%	12.8%	12.0%	28.7%	40.7%	12.0%
EB south	19.7%	12.0%	12.0%	8.2%	32.2%	40.3%	19.2%
K north	20.0%	13.2%	14.0%	13.5%	25.0%	38.5%	14.8%
K south	23.7%	15.5%	8.8%	8.2%	31.5%	39.7%	18.5%
F east	19.2%	10.8%	14.2%	10.5%	26.7%	37.2%	22.2%
F west	23.0%	11.7%	21.8%	10.2%	26.0%	36.2%	11.3%
G east	22.2%	12.8%	18.7%	8.7%	27.0%	35.7%	14.7%
G west	22.3%	16.3%	19.2%	9.5%	26.0%	35.5%	11.8%
C east	18.5%	18.8%	9.8%	12.3%	27.2%	39.5%	18.0%
C west	18.3%	24.5%	8.2%	13.0%	28.0%	41.0%	8.0%
N east	20.7%	10.7%	17.7%	9.2%	26.3%	35.5%	18.8%
N west	20.5%	9.8%	16.5%	12.3%	27.0%	39.3%	20.7%
D east	27.7%	16.8%	9.5%	10.0%	24.3%	34.3%	14.8%
D west	16.8%	14.2%	14.0%	12.3%	27.2%	39.5%	14.7%
I north	16.8%	17.3%	11.0%	10.8%	28.5%	39.3%	19.8%
I south	20.2%	14.8%	13.7%	9.2%	29.8%	39.0%	19.7%
J2 north	24.8%	15.3%	9.7%	12.5%	29.7%	42.2%	13.2%
J2 south	22.3%	11.2%	10.0%	12.2%	28.0%	40.2%	24.7%
B east	12.5%	18.3%	13.3%	10.0%	28.5%	38.5%	25.0%
B west	8.2%	12.5%	7.8%	16.5%	37.3%	53.8%	25.8%
H south	28.2%	22.7%	14.2%	4.3%	10.3%	14.7%	22.3%
H north	21.5%	21.2%	11.7%	7.0%	13.8%	20.8%	25.5%
Mean	0.202	0.148	0.132	0.105	0.275	0.380	0.182
SD	0.042	0.037	0.037	0.025	0.058	0.075	0.051
SE	0.009	0.008	0.008	0.005	0.012	0.015	0.010
CI 95%	0.018	0.016	0.016	0.010	0.024	0.032	0.022

Similarity between plots
year 2000
perennial grass total cover
SD=0.075







Similarity between plots
Year 2000
Tree & Shrub Cover
SD=0.05

W-A west
4/29/00

Cover	0m	20m	40m	60m	80m	100m	Total Co
Soil	11	8	7	10	7	4	7.8%
Rock	12	13	19	8	17	3	12.0%
Forb	3	6	5	2	0	3	3.2%
Litter	12	8	8	7	12	7	9.0%
SCCI bas	6	3	2	2	6	2	3.5%
" leaf	11	15	13	17	13	13	13.7%
BOHI	1	0	1	2	1	0	0.8%
" leaf	0	1	1	4	0	1	1.2%
BORAD	4	4	5	8	3	0	4.0%
" leaf	7	12	8	13	6	4	8.3%
BOCU	1	0	3	0	0	4	1.3%
" leaf	2	5	4	4	2	12	4.8%
MUEM	2	3	1	1	2	3	2.0%
" leaf	4	3	0	0	2	6	2.5%
ERIN	0	0	0	1	0	1	0.3%
" leaf	2	0	1	3	4	5	2.5%
Bromus	0	2	3	3	2	1	1.8%
" leaf	2	3	5	5	2	3	3.3%
BOBA	0	0	0	0	0	1	0.2%
" leaf	0	0	0	0	0	3	0.5%
NOMI	3	12	5	4	9	11	7.3%
Grass ✓	16	14	21	9	13	12	14.2%
Quercus	2	0	17	11	4	12	7.7%
JUDE ✓	3	0	0	3	6	2	2.3%
Manzanit	2	0	1	0	2	4	1.5%

Agave	3	0	0	1	0	0	0.7%

W-A east
4/29/00

Cover	0m	20m	40m	60m	80m	100m	Total Co
Soil	17	7	13	9	15	10	11.8%
Rock	19	19	25	13	17	15	18.0%
Forb	2	1	1	1	0	0	0.8%
Litter	12	9	10	11	14	20	12.7%
SCCI bas	1	3	4	2	1	1	2.0%
" leaf	6	13	10	9	5	7	8.3%
BOHI	0	0	0	0	1	0	0.2%
" leaf	1	1	5	4	1	1	2.2%
BORAD	1	3	2	2	3	2	2.2%
" leaf	7	5	4	3	7	3	4.8%
LYPH	0	0	0	0	1	0	0.2%
" leaf	0	1	2	0	1	1	0.8%
BOCU	0	0	0	0	1	0	0.2%
" leaf	1	2	0	1	0	3	1.2%
MUEM	1	4	5	1	4	3	3.0%
" leaf	5	3	4	2	5	6	4.2%
BOGR	0	0	0	0	0	0	0.0%
" leaf	0	0	0	0	0	0	0.0%
ERIN	0	0	0	3	0	1	0.7%
" leaf	0	0	3	5	4	7	3.2%
ARIST	0	0	0	0	0	0	0.0%
" leaf	0	0	1	0	0	0	0.2%
Bromus	0	2	1	0	4	1	1.3%
" leaf	3	5	3	4	3	2	3.3%
BOBA	0	0	0	0	0	0	0.0%

" leaf	0	2	0	0	0	0	0.3%
Quercus	4	21	11	16	9	12	12.2%
NOMI	10	3	3	4	11	6	6.2%
Manzanit	11	0	0	12	0	4	4.5%
Grass	12	15	16	22	17	7	14.8%
JUDE	0	4	0	0	0	0	0.7%
Agave	0	0	2	0	0	1	0.5%
MIBI	0	0	0	0	0	2	0.3%
							120.7%

Peloncillo Watersheds Study - Graminoids

SCIENTIFIC NAME	SYMBOL	COMMON NAME	SYNONYM
Aristida adscensionis	ARAD	sixweeks threeawn	
Aristida schiedeana var. orcuttiana	ARSCO	single threeawn	Aristida orcuttiana
Aristida spp.	ARIST	threeawn	
Bothriochloa barbinodis	BOBA3	cane bluestem	Andropogon barbinodis
Bouteloua curtipendula	BOCU	sideoats grama	
Bouteloua gracilis	BOGR2	blue grama	
Bouteloua hirsuta	BOHI2	hairy grama	
Bouteloua radicosa	BORA	purple grama	
Elionurus barbiculmis	ELBA	woolyspike balsamscale	
Eragrostis intermedia	ERIN	plains lovegrass	
Lycurus setosus	LYSE3	bristly wolftail	Lycurus phleoides
Muhlenbergia emersleyi	MUEM	bullgrass	
Muhlenbergia rigida	MURI3	purple muhly	
Piptochaetium fimbriatum	PIFI	pinyon ricegrass	Stipa fimbriatum
Schizachyrium cirratum	SCCI2	Texas bluestem	Andropogon cirratus
Vulpia octoflora var. octoflora	VUOCO	sixweeks fescue	Festuca octoflora

Peloncillo Watersheds Study - Forbs

SCIENTIFIC NAME	SYMBOL	COMMON NAME	SYNONYM
Ambrosia spp.	AMBRO	ragweed	
Androsace occidentalis	ANOC2	western jockjasmine	
Artemisia ludoviciana	ARLU2	Louisiana sagewort	
Astragalus spp.	ASTRA	milkvetch	
Bommeria hispida	BOHI	copper fern	Gymnopteris hispida
Cheilanthes bonariensis	CHBO5	golden lipfern	Notholaena aurea
Cheilanthes fendleri	CHFE2	Fendler's lipfern	
Cheilanthes lindheimeri	CHLI	fairyswords	
Cheilanthes tomentosa	CHTO2	wooly lipfern	
Cirsium spp.	CIRSI	thistle	
Corydalis aurea	COAU2	scrambled eggs	
Descurainia pinnata	DEPI	western tansymustard	
Dichelostemma capitatum spp. capitatum	DICAC5	bluedicks	Dichelostemma pulchellum
Draba cunefolia	DRCU	wedgeleaf whitlowgrass	
Erigeron flagellaris	ERFL	trailing fleabane	Erigeron nudiflorus
Gilia mexicana	GIME	El Paso gilia	
Gnaphalium spp.	GNAPH	cudweed	

Peloncillo Watersheds Study - Forbs

SCIENTIFIC NAME	SYMBOL	COMMON NAME	SYNONYM
Linanthus aureus	LIAU	golden deserttrumpets	
Lotus greenei	LOGR4	Greene's bird'sfoot trefoil	
Mimulus rubellus	MIRU	little redstem monkeyflower	
Myosurus cupulatus	MYCU	Arizona mousetail	
Nuttallanthus texanus	NUTE	Texas toadflax	Linaria texana
Pellaea intermedia	PEIN	intermediate cliffbrake fern	
Phlox gracilis	PHGR16	slender phlox	Microsteris gracilis
Plagiobothrys arizonicus	PLAR	bloodweed, Arizona popcornflower	
Plantago spp.	PLANT	plantain	
Thlaspi montana var. fendleri	THMOF	Fendler's pennycress	Thlaspi fendleri
Triodanis perfoliata	TRPE4	clasping Venus looking-glass	
Uropappus lindleyi	URLI5	Lindley's silverpuffs	Microseris lindleyi, Microseris linearifolia
Veronica peregrina	VEPE2	neckweed	

Peloncillo Watersheds Study - Shrubs

SCIENTIFIC	SYMBOL	COMMON NAME	SYNONYM
Agave palmeri	AGPA3	Palmer's century plant	
Arctostaphylos pungens	ARPU5	pointleaf manzanita	
Baccharis pteronioides	BAPT	yerba de pasmo	
Cercocarpus montanus var. paucidentatus	CEMOG	hairy mountain mahogany	Cercocarpus breviflorus
Echinocereus rigidissimus	ERCI3	rainbow hedgehog cactus	Echinocereus pectinatus var. rigidissimus
Ericameria laricifolia	ERLA12	turpentinebush	Haplopappus laricifolius
Eriogonum wrightii	ERWR	bastardsage	
Escobaria vivipara var. bisbeeana	ESVIB	Bisbee spinystar cactus	Coryphantha vivipara var. bisbeeana
Garrya wrightii	GAWR3	Wright's silktassel	
Mimosa aculeaticarpa var. biuncifera	MIACB	wait-a-minute bush, mimosa	Mimosa biuncifera
Nolina microcarpa	NOMI	sacahuista	
Opuntia spinosior	OPSP2	cane cholla	Cylindropuntia spinosior
Opuntia spp.	OPUNT	pricklypear, cholla	
Quercus toumeyi	QUTO2	Toumey's oak	
Rhus trilobata var. pilosissima	RHTRP	pubescent squawbush	Rhus aromatica var. pilosissima
Yucca baccata	YUBA	banana yucca	
Yucca schottii	YUSC	Schott's yucca	

Peloncillo Watersheds Study - Trees

SCIENTIFIC NAME	**SYMBOL**	**COMMON NAME**	**SYNONYM**
Juniperus coahuilensis	JUCO11	redberry juniper	Juniperus erythrocarpa
Juniperus deppeana	JUDE2	alligator juniper	
Pinus cembroides	PICE	border pinyon, Mexican pinyon	Pinus discolor
Quercus emoryi	QUEM	Emory's oak	
Quercus grisea	QUGR3	gray oak	
Quercus toumeyi	QUTO2	Toumey oak	
Quercus x spp.	QUERC	oak; many crosses possible	

Ecological Type: Lithic Haplustolls HSM 4, -1
loamy-skeletal, mixed, superactive, mesic
JUDE2/QUEM/NOMI/BORA

N = 1

Scientific Name	Constancy %	Average Cover %
Trees		
Juniperus deppeana	100	3
Quercus emoryi	100	3
Shrubs		
Agave palmeri	100	0.8
Arctostaphylos pungens	100	T
Echinocereus rigidissimus	100	0.1
Eriogonum wrightii	100	0.7
Nolina microcarpa	100	0.5
Opuntia spp.	100	T
Quercus toumeyi	100	7
Yucca schottii	100	1
Forbs		
Androsace occidentalis	100	0.1
Bommeria hispida	100	T
Cheilanthes fendleri	100	0.2
Cheilanthes lindheimeri	100	0.1
Corydalis aurea	100	0.1
Descurainia pinnata	100	T
Dichelostemma capitatum spp. capitatum	100	T
Erigeron flagellaris	100	T
Gilia mexicana	100	T
Gnaphalium spp.	100	T
Nuttallanthus texanus	100	T
Plantago spp.	100	T
Uropappus lindleyi	100	T
Graminoids		
Aristida adscensionis	100	T
Aristida schiedeana var. orcuttiana	100	2
Bouteloua curtipendula	100	1
Bouteloua hirsuta	100	2
Bouteloua radicosa	100	5
Eragrostis intermedia	100	0.5
Lycurus setosus	100	0.5
Muhlenbergia emersleyi	100	2
Schizachyrium cirratum	100	0.5
Vulpia octoflora var. octoflora	100	T

Ecological Type: Lithic Argiustolls HSM 4, -1
clayey-skeletal, mixed, superactive, mesic
JUDE2/QUEM/NOMI/BORA

N = 5

Scientific Name	Constancy %	Average Cover %
Trees		
Juniperus deppeana	100	3.8
Quercus emoryi	100	7
Shrubs		
Agave palmeri	80	0.4
Arctostaphylos pungens	40	2
Baccharis pteronioides	40	0.1
Eriogonum wrightii	20	0.1
Escobaria vivipara var. bisbeeana	40	T
Mimosa aculeaticarpa var. biuncifera	60	0.2
Nolina microcarpa	100	9.4
Opuntia spinosior	40	T
Opuntia spp.	20	T
Yucca schottii	40	1.1
Forbs		
Androsace occidentalis	20	T
Artemisia ludoviciana	20	T
Cirsium spp.	20	T
Descurainia pinnata	20	T
Dichelostemma capitatum spp. capitatum	20	T
Draba cunefolia	20	T
Erigeron flagellaris	20	T
Gilia mexicana	20	T
Gnaphalium spp.	20	T
Mimulus rubellus	20	T
Nuttallanthus texanus	20	T
Plagiobothrys arizonicus	20	T
Plantago spp.	40	T
Uropappus lindleyi	20	T
Graminoids		
Aristida schiedeana var. orcuttiana	80	1.7
Aristida spp.	20	2
Bouteloua curtipendula	60	3.7
Bouteloua hirsuta	100	1.7
Bouteloua radicosa	100	12.6
Eragrostis intermedia	40	0.7
Lycurus setosus	80	0.7
Muhlenbergia emersleyi	100	1.7
Schizachyrium cirratum	100	13
Vulpia octoflora var. octoflora	40	T

Ecological Type: Lithic Argiustolls HSM 4, -1
loamy-skeletal, mixed, superactive, mesic
QUEM/NOMI/BOHI2

N = 1

Scientific Name	Constancy %	Average Cover %
Trees		
Juniperus deppeana	100	0.1
Quercus emoryi	100	7
Shrubs		
Eriogonum wrightii	100	0.8
Escobaria vivipara var. bisbeeana	100	T
Nolina microcarpa	100	10
Forbs		
Androsace occidentalis	100	T
Artemisia ludoviciana	100	T
Astragalus spp.	100	T
Cirsium spp.	100	T
Descurainia pinnata	100	T
Draba cunefolia	100	T
Erigeron flagellaris	100	T
Gilia mexicana	100	T
Linanthus aureus	100	0.1
Mimulus rubellus	100	T
Myosurus cupulatus	100	T
Nuttallanthus texanus	100	T
Plantago spp.	100	T
Uropappus lindleyi	100	T
Graminoids		
Aristida schiedeana var. orcuttiana	100	3
Bouteloua curtipendula	100	2
Bouteloua gracilis	100	6
Bouteloua hirsuta	100	15
Bouteloua radicosa	100	0.3
Eragrostis intermedia	100	0.8
Lycurus setosus	100	4
Muhlenbergia emersleyi	100	2
Schizachyrium cirratum	100	7
Vulpia octoflora var. octoflora	100	T

Ecological Type: Lithic Haplustolls HSM 4, 0
loamy-skeletal, mixed, superactive, mesic
PICE/JUDE2/QUEM/BOGR2

N = 4

Scientific Name	Constancy %	Average Cover %
Trees		
Juniperus coahuilensis	25	2
Juniperus deppeana	100	1.9
Pinus cembroides	100	5.2
Quercus emoryi	100	10.5
Shrubs		
Arctostaphylos pungens	75	6.6
Ericameria laricifolia	25	0.1
Eriogonum wrightii	75	0.4
Garrya wrightii	100	6
Nolina microcarpa	100	10.2
Opuntia spinosior	50	0.3
Opuntia spp.	50	T
Yucca baccata	25	5
Yucca schottii	100	1.1
Forbs		
Artemisia ludoviciana	25	T
Cheilanthes tomentosa	25	T
Descurainia pinnata	25	0.2
Draba cunefolia	25	T
Gnaphalium spp.	25	T
Nuttallanthus texanus	25	T
Graminoids		
Aristida adscensionis	25	T
Aristida schiedeana var. orcuttiana	75	3.7
Aristida spp.	75	2.8
Bothriochloa barbinodis	25	0.5
Bouteloua curtipendula	50	0.1
Bouteloua gracilis	100	2.2
Bouteloua hirsuta	50	0.4
Bouteloua radicosa	75	0.6
Elionurus barbiculmis	25	0.2
Eragrostis intermedia	50	0.1
Lycurus setosus	75	1.2
Muhlenbergia emersleyi	100	0.3
Schizachyrium cirratum	100	4.4
Vulpia octoflora var. octoflora	25	T

Ecological Type: **Typic Ustorthents HSM 4, 0**
loamy-skeletal, mixed, superactive, mesic
PICE/JUDE2/QUEM/BOGR2

N = 1

Scientific Name	Constancy %	Average Cover %
Trees		
Juniperus deppeana	100	1
Pinus cembroides	100	3
Quercus emoryi	100	6
Shrubs		
Baccharis pteronioides	100	0.2
Eriogonum wrightii	100	0.4
Garrya wrightii	100	0.2
Nolina microcarpa	100	12
Opuntia spp.	100	0.1
Forbs		
Ambrosia spp.	100	T
Corydalis aurea	100	T
Descurainia pinnata	100	T
Draba cunefolia	100	T
Gilia mexicana	100	T
Nuttallanthus texanus	100	T
Pellaea intermedia	100	T
Graminoids		
Aristida adscensionis	100	0.5
Aristida schiedeana var. orcuttiana	100	6
Bouteloua curtipendula	100	T
Bouteloua gracilis	100	5
Eragrostis intermedia	100	0.1
Lycurus setosus	100	3
Muhlenbergia emersleyi	100	0.1
Schizachyrium cirratum	100	3
Vulpia octoflora var. octoflora	100	T

Ecological Type: Lithic Ustorthents HSM 4, 0
loamy-skeletal, mixed, superactive, mesic
PICE/JUDE2/QUEM/BOGR2-BORA

N = 2

Scientific Name	**Constancy %**	**Average Cover %**
Trees		
Juniperus coahuilensis	50	1
Juniperus deppeana	100	8.5
Pinus cembroides	100	2.1
Quercus emoryi	100	8
Shrubs		
Agave palmeri	100	0.1
Arctostaphylos pungens	50	4
Ericameria laricifolia	50	T
Eriogonum wrightii	50	0.1
Garrya wrightii	100	0.6
Nolina microcarpa	100	6.5
Opuntia spinosior	50	0.1
Rhus trilobata var. pilosissima	50	0.4
Yucca schottii	50	0.7
Forbs		
Ambrosia spp.	50	T
Cheilanthes tomentosa	50	T
Descurainia pinnata	50	0.1
Draba cunefolia	50	T
Mimulus rubellus	50	T
Nuttallanthus texanus	50	T
Pellaea intermedia	50	T
Graminoids		
Aristida schiedeana var. orcuttiana	100	3
Bouteloua curtipendula	100	2
Bouteloua gracilis	100	2
Bouteloua hirsuta	50	0.2
Bouteloua radicosa	100	13.1
Lycurus setosus	100	1.6
Muhlenbergia emersleyi	100	1
Schizachyrium cirratum	100	9.5
Vulpia octoflora var. octoflora	50	T

Ecological Type: Lithic Argiustolls HSM 4, -1
loamy-skeletal, mixed, superactive, mesic
JUDE2/QUEM/NOMI/BOGR2-BORA

N = 4

Scientific Name	**Constancy %**	**Average Cover %**
Trees		
Juniperus deppeana	100	2.5
Quercus emoryi	100	10.5
Quercus grisea	50	9.5
Shrubs		
Agave palmeri	50	0.1
Arctostaphylos pungens	25	4
Ericameria laricifolia	25	T
Eriogonum wrightii	75	0.2
Escobaria vivipara var. bisbeeana	50	T
Mimosa aculeaticarpa var. biuncifera	50	0.2
Nolina microcarpa	100	6.7
Opuntia spinosior	75	T
Opuntia spp.	50	0.1
Rhus trilobata var. pilosissima	50	0.5
Yucca schottii	100	1
Forbs		
Androsace occidentalis	25	0.1
Artemisia ludoviciana	25	T
Descurainia pinnata	50	T
Dichelostemma capitatum spp. capitatum	25	T
Draba cunefolia	25	T
Erigeron flagellaris	25	T
Linanthus aureus	25	T
Mimulus rubellus	25	T
Myosurus cupulatus	25	0.1
Nuttallanthus texanus	25	T
Plagiobothrys arizonicus	50	T
Plantago spp.	50	T
Uropappus lindleyi	25	T
Graminoids		
Aristida schiedeana var. orcuttiana	50	2
Aristida spp.	25	4
Bouteloua curtipendula	100	4.6
Bouteloua gracilis	50	10
Bouteloua hirsuta	75	2.3
Bouteloua radicosa	100	5.6
Eragrostis intermedia	50	0.7
Lycurus setosus	75	0.3
Muhlenbergia emersleyi	75	2.3
Schizachyrium cirratum	100	8.7
Vulpia octoflora var. octoflora	25	T